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IYATOMI (K.). **Quantitative Studies on the Parasitism of *Trichogramma dendrolimi*, an Egg-parasite of European Corn Borer.** [*In Japanese.*]—*Zool. Mag.* **51** no. 7 pp. 393–406, 3 figs., 13 refs. Tokyo, 1939. (With a Summary in English.) [Recd. 1940.]

A formula is quoted by which the probable number of hosts that will receive a given number of parasites can be calculated if the distribution of parasite progeny is entirely random, and reference is made to the experiments from which Salt concluded that ovipositing females of certain parasites can distinguish healthy hosts from those already parasitised [*R.A.E.*, A **22** 204]. If this is the case, the number of hosts with only one parasite will be higher than the calculated value for random distribution and the numbers of unparasitised hosts and of those with two or more parasites will be lower.

According to statistical analysis of the parasitism of 155 egg-masses of the European corn borer [*Pyrausta nubilalis*, Hb.] by *Trichogramma dendrolimi*, Mats., the distribution of the parasites was intermediate between perfect and random distribution. When, however, the number of parasites was not more than half that of the host, the observed proportion of polyparasitism was greater than that expected from random distribution. The author considers that the ability of ovipositing females to discriminate between healthy and parasitised hosts is not the principal factor influencing the distribution of the parasites.

ANDREWARTHA (H. G.). **The Environment of the Australian Plague Locust (*Chortoicetes terminifera* Walk.) in South Australia.**—*Trans. roy. Soc. S. Aust.* **64** no. 1 pp. 76–94, 9 figs., 4 pls., 17 refs. Adelaide, 1940.

Field observations in South Australia [*cf. R.A.E.*, A **26** 584] have shown that *Chortoicetes terminifera*, Wlk., is widespread, but restricted to particular habitats. In the southern agricultural zone, which receives winter rainfall, it becomes reduced in numbers between outbreaks and is associated with relatively dry situations. The outbreak area, the topography, soils and vegetation of which are described [*cf.* **26** 703], lies in the semi-arid belt to the north. In it, the scarcity of rainfall leads to the absence of a regular drainage system and the creation of local situations, such as temporary watercourses, depressions and flats, that receive the run-off from the surrounding country, have a more humid ecoclimate, and serve as restricted habitats for the locust. The percentage of ephemeral and herbaceous perennial plants, of which *Eragrostis setifolia* and *E. dielsi*, which are the most characteristic plants of the locust habitats and which can rapidly produce luxuriant growth and provide abundant food after the rains, is high. Finally, the variability of the rainfall régime sometimes results in a run of good seasons, required for the production of swarms.

An analysis was made of climatic records for the outbreak and invasion areas of *C. terminifera* in South Australia. For this, the monthly rainfall-evaporation ratio (P/E) was used as an index to soil moisture [*cf.* **24** 69], and a ratio of PT/$\frac{1}{2}$e, in which P is the total rainfall, T the mean daily effective temperature (*i.e.* temperature over 16·5°C. [61·7°F.], which is the developmental zero for embryonic

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development), and e the estimated mean daily evaporation, for each month, served as an index to favourable conditions. The outbreak area was found to be approximately delimited in the south by the 16°C. [60·8°F.] isotherm for maximum temperatures in winter, and by the isoline for P/E not greater than 0·5. South of this limit, the high winter rainfall and temperatures near and below the developmental zero inhibit the production of swarms.

The application of PT/$\frac{1}{2}$e formula to climatic records for the period preceding and during the outbreak of 1931–35 [*cf.* **25** 348] showed that all parts of the outbreak area experienced numerous periods favourable for breeding of *C. terminifera* between 1931 and 1934. It is concluded that favourable weather for several successive years is necessary before a major outbreak can occur. For the outbreak to continue in the agricultural area, which is invaded by swarms that have developed further north, a dry summer and a dry cold winter are necessary, to inhibit the development of eggs laid in that area until the next spring.

Since the outbreak area of *C. terminifera* in South Australia is vast and thinly populated, it is not practicable to attempt destruction of locusts within it, or to modify their environment. Control measures should, therefore, aim at the destruction of locusts in the agricultural areas.

NAUDÉ (T. J.). **Insects and Human Affairs.**—*Pamphl. S. Afr. biol. Soc.* no. 10 pp. 67–77. Pretoria, 1939. [Recd. 1940.]

Attention is drawn to the great antiquity of insects as proved by geological records, their abundance and the diversity of their structure and bionomics, and to the important place they have assumed as crop pests during the last two centuries, during which period fresh parts of the world have been developed and crops produced on an unprecedented scale. The adverse effect of insect life on man is stated to be now greater than ever before, and figures are quoted to give an indication of the extent of the financial loss they cause. The influence of man's activities on insect problems is shown, and particular importance is attached to the great increase in travel and trade intercourse. A brief historical outline is given of work on insect control. In conclusion, reference is made to the various activities of beneficial insects.

MASSEE (A. M.). *Ceratitis capitata* **Wied. (Dipt. Trypetidae) in Middlesex.**—*Ent. mon. Mag.* **76** no. 5 p. 112, 1 ref. London, 1940.

Ceratitis capitata, Wied., is frequently introduced into England in imported fruits, but has not recently been recorded breeding in nature there. In 1939, however, Cox's Orange Pippin apples from a tree in a small garden in Middlesex were found to be infested with maggots that caused premature dropping of the fruit, and two adults reared in November proved to be a male and female of *C. capitata*. Injury consisted in tunnelling into the flesh and the formation of soft areas under the skin ; the surface of the fruit was apparently undamaged. None of the three other fruit trees in the garden (apples and a pear)

was infested, but all fruits in the garden were destroyed as a precautionary measure and the soil under the trees treated with an insecticide. A neighbouring greengrocer's shop is thought to have been the source of infestation.

FEYTAUD (J.) & DE LAPPARENT (P.). **Influence de la température sur le pouvoir insecticide des poudres roténonées.**—*C.R. Acad. Agric. Fr.* **26** no. 11 pp. 408–412, 2 refs. Paris, 1940.

In the course of tests, by a method already noticed [*R.A.E.*, A **28** 530], of powders containing rotenone on fourth-instar larvae of *Leptinotarsa decemlineata*, Say, it has been observed that the time required for the larvae to become completely paralysed varies with the temperature. Further trials were therefore conducted in December 1939 and January 1940 to determine the influence of such temperatures as occur in France during the season when insecticides are applied against the larvae.

A cubé dust containing 6 per cent. rotenone, either alone or diluted with talc to contain 0·9 per cent. rotenone, was used in four series of laboratory tests, made under artificial light and at 28°C. [82·4°F.] and 24°C. [75·2°F.], representing daily variations in summer temperature, at 15°C. [59°F.], which is a frequent temperature in spring when the larvae first appear and which also occurs sometimes in summer, and at 10°C. [50°F.], at which activity almost ceases. There was no substantial difference in the rate of action of the two dusts at any one temperature, but the talc appeared to exert a desiccating effect that assisted the lethal action of the rotenone. High temperatures accelerated the action, and at the lower temperatures the initial action was retarded and the length of time needed to induce paralysis increased, but mortality was not impaired. The application of rotenone dusts during the warmest part of the day is therefore recommended, especially when there is a risk of the dust being quickly removed from the leaves by wind or rain.

In a further test at approximately the same temperatures on 9th March, the effectiveness of the cubé-talc mixture was found to be unaffected by darkness.

NOTINI (G.). **Studier över arsenikpudermedlens inverkan på bin.** [Studies on the Effect of Arsenical Dusts on Bees.]—*Med. St. Växtskyddsanst.* no. 30, 12 pp., 3 figs., 34 refs. Stockholm, 1939. [Recd. 1940.]

Considerable mortality was caused among honey-bees in apiaries near Stockholm in May 1938 owing to the use in a neighbouring strawberry plantation of an arsenical dust for the control of the raspberry weevil [*Anthonomus rubi*, Hbst.]. The symptoms of the poisoned bees are described. Analyses of some of the many thousands of dead bees that were found on the ground showed that the content of metallic arsenic per individual averaged 2·31 mmg., which is considerably more than the minimum lethal dose [*R.A.E.*, A **23** 299, etc.]. In a discussion, it is pointed out that the use of arsenical sprays involves comparatively little danger to bees, since they avoid pollen that is moist, and even if a lethal dose of the arsenical were absorbed with nectar or water, this will not involve the death of the brood, but only of the individual that ingests it. The use of arsenical dusts is far more

dangerous to bees, as they apparently possess only a very slight capacity for recognising uncontaminated pollen, and poison that is introduced into the hive with pollen may cause serious mortality among the brood and lead to the extinction of the colony. Measures to be taken in cases of suspected poisoning are briefly discussed.

BUTOVITSCH (V.) & SPAAK (H.). **Studier och försök att skydda i skogen kvarliggande timmer mot insekter och svampar jämte beräkningar av konserveringsmetodernas ekonomiska förutsättningar.** [Studies and Experiments on the Protection against Insects and Fungi of Timber lying in the Forest, together with Estimates of the economic Practicability of the Methods of Preservation.]—*Norrland SkogsvFörb. Tidskr.* 1939 Häfte 3 repr. 120 pp., 24 figs., 3 refs. Stockholm, 1939. (With a Summary in German.) [Recd. 1940.]

As a result of severe storms in the autumn of 1937 and the spring of 1938, considerable damage was caused to forests of pine and spruce in a region on the coast of central Sweden. Much of the fallen wood could not be removed before the summer of 1938, and advantage was taken of this to test the value of various measures in preserving it from deterioration and attack by insects. The logs, some of which were barked, were stacked up on ground of varying moisture content in forest districts and covered with a layer of brushwood or moss [*cf. R.A.E.*, A **23** 224]. Some of the logs were treated with chemicals before being stacked, and some stacks were erected in pits about 20 ins. deep in swampy ground and covered with damp sphagnum moss. The work was begun at the beginning of April and was completed in 2–3 weeks. During this period, many of the pine logs became infested by *Myelophilus* (*Blastophagus*) *piniperda*, L., and *M.* (*B.*) *minor*, Htg., and these were removed from the stacks.

The wood was examined in October 1938, and the results are given in detail in tables and graphs and discussed. They showed that, in general, and irrespective of treatment, pine was attacked to a much greater extent than spruce, the percentage of total surface area infested being 31·6 for the former and only 11·4 for the latter. On spruce, infestation was less severe on the lower than on the upper surface of the log, but this difference was not apparent in the case of pine. The upper layer in the stack was more infested than the lower, and infestation of pine was as severe in the middle layer as in the upper one. As indicated by the surface area of the infested wood, by far the greatest damage to pine was caused by weevils of the genus *Pissodes* ; *M. piniperda*, *M. minor* and *Hylastes ater*, Payk., were much less injurious, and only slight injury was caused by *H. palliatus*, Gylh., and *Dryocoetes* spp. The last-named caused almost half the total injury to spruce, followed by *Tetropium* spp. *Pissodes*, *H. palliatus* and *H. cunicularius*, Er., caused only slight damage.

Some of the wood was attacked by blue-stain fungi, of which, in the case of pine, *M. minor* was the principal vector, followed by *H. ater*. On spruce, the fungi were associated with *Tetropium*, *Dryocoetes*, and *H. cunicularius*. With a constant insect population, the amount of blue-staining was inversely proportionate to the dampness of the substratum. A limitation of the size of the insect population due to soil moisture was observed only in the lower layers of the stacks, and it is therefore concluded that it is not sufficient to erect the stacks

on damp soil and cover them with material, such as brushwood, that allows moisture to evaporate during the summer. Better protection against both insects and blue-stain fungi would be provided by a covering that would preserve the damp cold atmosphere of the stacks for as long a period as possible.

Of the chemicals applied to the logs before stacking, only a 5 per cent. solution of sodium arsenite afforded any protection against insects, and although logs treated with it showed the least infestation of any in the stacks on the surface of the soil, they were strongly infected with blue-stain fungi, the development of which is apparently favoured by arsenicals. The best protection of all was afforded by storing the logs in pits in marshy soil. Infestation of such logs was slight, and there was scarcely a trace of blue-staining, which is attributed to their increased water-content. This method of storage also led to the least deterioration in the quality of the timber.

For comparison, an examination was made of fallen logs that had lain untouched on the ground. Of 48 pines and 14 spruces, 43 and 7, respectively, had been attacked by insects. Injury to pine was by far the more severe, and was considerably more extensive than in the stacked wood. About half of the total infestation in both pine and spruce was due to *Pissodes*, and the proportion in pine due to *M. piniperda* and *M. minor* was about three times as great as in the stacks. Pine logs lying on wet ground were more resistant to insect attack and to blue-stain fungi than those lying on dry or merely damp sites.

To investigate the deterioration in quality of the timber, sample logs were sawn up and classified. The results are shown in tables and discussed in detail. It is concluded that the loss involved was reduced sufficiently for the timber to be usable; it was greatest in barked timber.

[Pospelova (V. M.).] **Поспелова (В. М.). The Tests of concentrating Baits as a Control Measure against** *Agriotes obscurus*. [*In Russian.*] —*Bull. Plant Prot.* no. 1 (20) pp. 38–43, 1 graph, 5 refs. Leningrad, 1939. [Recd. 1940.]

In the course of work on Elaterids in Western Siberia in 1937, experiments were carried out near Tomsk from 1st June to 11th July, during the period of the emergence and flight of the adults, on the value against them of trap-heaps of grass and other materials similar to those used against Tenebrionids [*cf. R.A.E.*, A **25** 662]. During this period, over 6,000 adults belonging to 7 species were taken, but almost all of them were *Agriotes obscurus*, L. [*cf.* **27** 679]. The trap-heaps, which consisted chiefly of *Agropyrum repens* and to a less extent of other plants or straw, and were usually 1 ft. high and 20 ins. in diameter, were distributed at various intervals in fields of potato, cabbage or other crops, and also on fallow land and on the grass strips dividing the fields. As the grass in the heaps dried up, freshly cut grass was added to the top. Counts were made every other morning, and the results are shown in tables. About twice as many beetles occurred in the heaps as on the soil under them and females were more numerous than males. Straw was the least attractive material, while hay proved an effective substitute for grass early in the spring, before the vegetation begins to sprout. From the data obtained, the author concludes that trap-heaps of grass are of considerable value in the control of *A. obscurus* in this region. They should be placed in the

fields in the second half of May, when the beetles appear on the surface of the soil, and should be left until the end of June. Good results are obtainable only on ground that is free from dense grass. Experiments in which marked beetles were released at various distances from trap heaps showed that the latter should be distributed at intervals of about 20 ft. It is essential to destroy the beetles daily, especially at the beginning of June, when the vegetation is still sparse and the beetles are attracted to the heaps in large numbers. It was found that the attractiveness of the trap-heaps is considerably increased by the addition of molasses, and 90–100 per cent. of the beetles in them were killed in 10 days when the grass was smeared with a mixture of 25 lb. molasses with 1 lb. sodium arsenite dissolved in 2 pints water.

[Vasil'ev (I. V.).] **Васильев (И. В.). Origin and World Distribution of *Bruchus pisorum* L.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 44–45, 1 map. Leningrad, 1939. [Recd. 1940.]

In view of the proposed increase in the cultivation of peas in the Russian Union, the author briefly discusses from the literature the world distribution and the probable country of origin of *Bruchus pisorum*, L. It is an important pest of peas (*Pisum sativum* and *P. arvense*) in the greater part of the south of European Russia, especially in the Ukraine, the Province of Rostov and the Caucasus, and is present up to approximately 54°N. latitude, but appears further north only in extremely favourable years. In Central Asia, it has been observed in Tashkent (Uzbekistan), Stalinabad (Tadzhikistan) and Alma-Ata (southern Kazakstan). In 1938 it was reported from Vladivostok, where it had probably been accidentally introduced.

[Chernuishev (P. K.).] **Чернышев (П. К.). About the Rate of Contamination of Grains by Pests.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 46–48. Leningrad, 1939. [Recd. 1940.]

The usual method of estimating the degree to which grain is infested with mites or weevils in the Russian Union is to count the numbers of these pests present in a sample (1 kg.) of the grain, which is then classified according to whether the numbers of weevils per sample are 5 or less, 5–10, and over 10, and those of the mites 20 or less, over 20, or so great that they form a continuous layer. The author points out that these figures do not in themselves give a true idea of the importance of the infestation, since the activity of the pests depends on such factors as the temperature and purity of the grain, the intactness of the seed-coats, and the presence of broken seeds. The most important factor, however, is the moisture content of the grain, and this should be correlated with the numbers of pests per sample in estimating the importance of an infestation. Grain with a moisture content of 13 per cent. or less is unfavourable for the development of grain mites and of the granary weevil [*Calandra granaria*, L.]; and they breed so slowly in grain containing 13·1–15·5 per cent. moisture that it can safely be stored for long periods. In moister grain, the weevils are very active, while the mites breed very rapidly and attack the endosperm of the seeds.

On the basis of these data, the author presents a revised scale in which the infestation of grain is classified into four groups, depending on the numbers of mites or weevils present in a sample and on its moisture content.

[Kamenskiĭ (S. A.) & Paĭkin (D. M.).] **Каменский (С. А.) и Пайкин (Д. М.). The Cause of the several Years Hibernation of the Beetles of the Beet Weevil.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 49–54, 10 refs. Leningrad, 1939. [Recd. 1940.]

Investigations in Russia on the bionomics of the beet weevil, *Cleonus* (*Bothynoderes*) *punctiventris*, Germ., the life-cycle of which from egg to adult is usually completed in 2–3 months, have shown that many of the weevils that have hibernated in their pupal cells remain dormant in the soil until a second winter has passed [*cf. R.A.E.*, A **24** 489]. V. P. Pyatnitzkiĭ has recently established that they may do so for as long as four consecutive years, which explains their occurrence in considerable numbers in old beet fields that have not been cultivated for two or three years [*cf.* **19** 428]. He considers that such protracted dormancy is due to the accumulation during development of the weevils of a large amount of fat, that the temperature, humidity and air-content of the soil affect the rapidity with which the fat is used up and determine the time of emergence of the weevils, and that in this connection the composition of the air in the soil, especially its content of carbon dioxide, is of particular importance.

Observations by the authors confirmed the fact that the life-cycle of *C. punctiventris* does not include a true diapause. The condition considered by some investigators to be a diapause is merely a state of dormancy induced by external factors unconnected with definite periods or definite stages in the development of the weevil. In laboratory experiments in 1939, dormancy did not result when the weevils were kept without food at 26°C. [78·8°F.] and various humidities. Although they lost weight, they remained active at all the humidities tested (25–100 per cent.), and survived for an average of 33 days at 25 per cent. humidity and 71 at 100 per cent. Feeding them on slightly dried leaves with a moisture content of 41 per cent. considerably reduced fertility and longevity, but did not induce dormancy. In experiments on the effect of temperature on the weevils [**28** 124], a sharp decrease in activity occurred at 2°C. [35·6°F.], and complete torpor ensued at 1·5°C. [34·7°F.] or less. Low temperatures cannot, however, be the sole factor concerned in dormancy, since the period during which the weevils remain in the soil includes months in which the temperature is much higher than that at which they resume activity.

Experiments were therefore carried out by means of a microrespirometer on the effect of varying concentrations of carbon dioxide and oxygen in the air. They showed that at 25–26°C. [77–78·8°F.], the weevils became dormant 1–1½ minutes after the concentration of carbon dioxide in the air was artificially increased to 40–50 per cent. by volume, or more. They did not then react to mechanical irritation or to light or temperature, but resumed activity 30 minutes after ventilation. When weevils were isolated in the apparatus and an alkali was introduced to absorb the carbon dioxide produced by respiration, they became dormant in 20 25 hours, owing to lack of oxygen. When the alkali was omitted and the carbon dioxide allowed to accumulate, this period was reduced to 15–20 hours. The percentage contents of oxygen and carbon dioxide in the atmosphere that induced dormancy were found to be about 9·5–15 and 8·6–5·6, and the amount of oxygen consumed by a weevil in an hour

at 26°C. was 35–50 cu. mm. O_2 per gm. live weight. The air present in normal soil only rarely contains a sufficiently low percentage of oxygen and high percentage of carbon dioxide to cause dormancy, but such conditions are sometimes produced by normal respiration in the earthen cells in which pupation and adult emergence take place in autumn. The walls of the cell are usually very compact and their inner surface is polished, so that the air in them is to a great extent isolated from that in the surrounding soil. The condition of the cell walls is the most important factor in the formation of an atmosphere that induces dormancy. In the field, dormancy ceases when the walls of the cell are damaged by mechanical means or by such factors as the freezing and thawing of the soil, or the growth of plant roots. On leaving the cells, the weevils make their way upwards, chiefly in search of the better aerated layers of the soil. Deep ploughing is, therefore, a valuable method of terminating dormancy, as it increases the air-content of the soil and destroys the pupal cells.

On the basis of these investigations, the authors conclude that dormancy in this weevil is not due directly to the accumulation of fat, which merely enables it to survive longer in the dormant state. When the fat reserve is exhausted the weevil dies, and this explains the presence in the soil of dead and desiccated individuals showing no trace of fungous disease.

[Vasser (R. É.).] **Baccep (P. З.). Oh the Biology of** *Pulvinaria aurantii* **Ckll. in Abkhasia.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 55–57. Leningrad, 1939. [Recd. 1940.]

Serious damage to various species of *Citrus* in Abkhazia is caused by *Pulvinaria aurantii*, Ckll., which is common in the districts of Sukhum and Gadauti on the Black Sea coast. It attacks the leaves, fruits and young shoots, but is rare on the trunks and branches. It weakens the trees, and its honey-dew favours the development of sooty mould. Persimmon (*Diospyros kaki*), loquat (*Eriobotrya japonica*), *Pittosporum tobira* and other plants, chiefly of Far Eastern origin, are also infested.

There are two complete generations a year, lasting about 100 and 260 days, respectively, and during the summer, and particularly in the autumn, all stages are found simultaneously. Second- and third-instar nymphs hibernate. In spring, the males are present in the second half of May. Eggs are deposited from about the end of May to the end of June, and again in September–October. The number laid in 10–15 days by a single female may range from a few hundred to 2,000. Oviposition is affected by temperature, and considerably fewer eggs are laid as soon as colder weather sets in in autumn. Counts of egg batches on mandarin trees situated in different parts of the plantations and experiments with artificially infested seedlings showed that the numbers of eggs laid are markedly higher on trees exposed to the sun and those having a high mean temperature. The egg stage lasts 15–20 days. The nymphs of the summer generation hatch in numbers at the end of June and throughout July, and those of the overwintering generation from the end of September to early November.

Little control of *P. aurantii* is exercised by insect enemies, though the eggs are sometimes destroyed by the larvae and adults of the Coccinellid, *Exochomus quadripustulatus*, L., but a fungus of the genus *Cephalosporium* attacks the nymphs and adults and is especially

abundant in the second half of the summer and in autumn, when it may destroy up to 70–80 per cent. of the Coccids. The development of the fungus is favoured by humidity and shade, and infestation by it is greater on the inner side of the crown and on trees in shady parts of the groves. The influence of exposure to the sun on the fertility of *P. aurantii* and the activity of the fungus was demonstrated in an experiment in which two mandarin plants in pots were each artificially infested in mid-July with 30 ovipositing females of the Coccid. Examination five weeks later showed 3,924 live Coccids in different stages of development on the plant exposed to the sun and only isolated individuals killed by the fungus, whereas on the plant kept in the shade the corresponding figures were 230 and 973.

[Shek (G.).] **Шек (Г.). On the Control of** *Pseudococcus citri* **Risso in Azerbaidjan.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 58–59, 1 fig., 3 refs. Leningrad, 1939. [Recd. 1940.]

In view of the failure to acclimatise *Cryptolaemus montrouzieri*, Muls., for the control of *Pseudococcus citri*, Risso, on grape-vines in Azerbaijan [*R.A.E.*, A **24** 704], and of the rapid reinfestation of vines sprayed with oil emulsions, preliminary experiments were carried out in September and October 1937 on fumigation with hydrocyanic acid gas. The fumigation tent was a piece of light gas-proof material hung over the upper wire of the espalier on which vines were trained so as to enclose 4–5 plants, the edges being joined with pegs. The gas was generated by the pot method from sodium cyanide, using 1 part to 1½ parts sulphuric acid and 3 parts water. The capacity of the tent varied from about 60 to 88 cu. ft., depending on the size of the vines, and from 20 to 50 gm. sodium cyanide was used per treatment. The period of exposure was 30 minutes. The percentage mortality obtained was estimated from counts of the live and dead mealybugs present on the vines 24 hours after fumigation. The results in three tests carried out on a sunny day in October at a temperature under the tent of 18–20·3°C. [about 66·5°F.] are shown in a table. The percentage mortality of the mealybug increased progressively from the lower branches of the vines to the upper ones, where it reached 99·2–100 ; it was low in the case of individuals sheltering under the bark, and in one test was only 74·2.

[Meĭer (N. F.).] **Мейер (Н. Ф). Methods of Mass Production of** *Trichogramma evanescens* **Westw.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 73–76, 12 refs. Leningrad, 1939. [Recd. 1940.]

The literature on the artificial breeding and cold storage of *Trichogramma* spp. is briefly reviewed, and an account is given of experiments to determine the effect of winter temperatures on eight of the nine Russian races of *T. evanescens*, Westw. [*R.A.E.*, A **27** 589], reared in eggs of the grain moth [*Sitotroga cerealella*, Ol.]. For this purpose, parasitised eggs glued on pieces of cardboard were placed in wide test tubes each containing 1,400–1,500. Pieces of light material were tied over the tops of the tubes and they were placed outdoors in a small shed that protected them from the sun, but was open on two sides, so that they eventually became almost covered with snow, from which only their tops protruded. Those containing parasites of the Azov-Black-Sea, Central Asiatic, Azerbaijan and Romnui races were placed in the shed in early September and those with the Saratov,

Astrakhan, dark brown Armavir and cabbage-white races in October ; the tubes were restored to the laboratory on 25th March. In the course of the winter the mean monthly temperature varied from 14·3 to —7°C. [57·74–19·4°F.], and temperatures between —10 and —20°C. [14 and —4°F.] were recorded on 8 days in December, 7 in January and 3 in February. The adults of the Romnui race began to emerge unexpectedly on 26th October, but they did not parasitise any of the eggs of *Sitotroga* that were offered to them. The tubes were transferred to the laboratory, and on the following day further emergence occurred. The test with this race was abandoned. The adults of the Central Asiatic and Azov-Black-Sea races started to emerge on 1st April, and those of the Saratov race on 2nd April. The average percentages of parasite emergence and of females obtained were 91·7, 85·7 and 65·6, and 72·3, 78·2 and 68·2, respectively. When ten fertilised females of each of these races were confined individually with eggs of *Sitotroga*, all parasitised the usual number of eggs (a mean of 17·1, 18·7 and 15·2 per female, respectively) and their progeny consisted chiefly of females (70·2–81·8 per cent.). No adults of the other four races emerged, and it is concluded that these races are unable to survive exposure to frost. This method of storage under natural conditions is simpler than storage in a refrigerator, while the percentage of parasite emergence is higher if the period of storage is considerable [*cf. loc. cit.*]. The tubes should be protected from the direct rays of the sun and allowed to become gradually covered with snow to avoid freezing.

[Telenga (N. A.).] **Теленга (Н. А.). Testing** *Trichogramma evanescens* **Westw. for the Control of** *Laspeyresia funebrana* **Tr.** [*In Russian.*] —*Bull. Plant Prot.* no. 1 (20) pp. 77–78. Leningrad, 1939. [Recd. 1940.]

On the Black Sea coast of the Caucasus, *Cydia* (*Laspeyresia*) *funebrana*, Treitschke, is the most important pest of prunes, infesting yearly over 60 per cent. of the fruits, most of which become totally unsuitable for drying. There are three generations during the summer. The larvae of the first attack the newly formed fruits, but those of the others develop in the ripening fruits and are the more harmful.

In experiments carried out in the summer of 1936 in Abkhasia on the possibility of utilising the egg-parasite, *Trichogramma evanescens*, Westw., the parasites were released on experimental plots in an orchard at rates of 1,000, 2,000 and 3,000 per tree. A first release was made against the second generation on 11th July, which was rather late, as the moths were on the wing at the end of June, and a second against the third generation on 29th July, when oviposition was at its peak. During the period of the harvest (19th August to 26th September) a total of 56,000 prunes from 142 trees was examined. The percentages of infested fruits from trees on which totals of 2,000, 4,000 and 6,000 parasites had been released averaged 55·4, 42·8 and 45·2, respectively, as compared with 60 from the controls.

[Evlakhova (A. A.).] **Евлахова (А. А.). A new Yeast-like Fungus** *Blastodendrion pseudococci* **nov. sp. pathogenic for Mealy Bugs.** [*In Russian.*]—*Bull. Plant Prot.* no. 1 (20) pp. 79–84, 3 figs., 17 refs. Leningrad, 1939. [Recd. 1940.]

In view of the absence of sufficiently effective measures for the control of mealybugs, investigations were carried out in Russia in

1935 to find a micro-organism pathogenic to them. For this purpose, examples of *Pseudococcus citri*, Risso, reared in the laboratory on etiolated potato shoots were kept under conditions of high humidity, which favoured the development of disease organisms and led to the death of the mealybugs. Of the large number of micro-organisms isolated from the dead individuals, *Bacterium prodigiosum* and a yeast-like fungus proved to be pathogenic. The latter, for which the name *Blastodendrion pseudococci*, sp. n., is proposed, was isolated in three instances from mealybugs kept under a bell jar at 25°C. [77°F.] and 100 per cent. relative humidity. An account is given of the morphological and physiological characters of this fungus, its development on different nutritive media and the effect of different temperatures on it. It developed most rapidly at 30–35°C. [86–95°F.].

To test its pathogenicity to *P. citri*, experiments were carried out with the initial culture and also one of increased virulence obtained by repeated passage through the mealybugs. From 15 to 20 mealybugs were placed on the stems of etiolated potato plants previously smeared with the culture, which was usually grown on an agar medium. The temperature during the tests varied from 18 to 32°C. [64·4–89·6°F.] and the relative humidity from 40 to 100 per cent. In most of the experiments at 25°C. and 60–70 per cent. humidity, the percentage mortality of the mealybugs ranged up to 50, and when the culture of increased virulence was used, it was sometimes 100. The mealybugs died in 24 hours with the usual symptoms of the infection, and the fungus was recovered from their bodies. Spraying the Coccids with a suspension of the culture in water or must was less effective. The controls usually remained healthy.

Examination of histological sections prepared from infected mealybugs showed that the fungus enters the body through the digestive tract and penetrates into the fat-body and the muscular system. It did not penetrate the integument.

The literature on fungi that develop on mealybugs is briefly reviewed.

TAKAHASHI (R.). **Some Aleyrodidae from Mauritius (Homoptera).**—*Insecta matsum.* **14** no. 1 pp. 1–5, 2 figs. Sapporo, 1940.

This paper comprises descriptions of 3 new species of Aleurodids with notes on others, including *Bemisia tabaci*, Gennadius, of which many pupal cases and a few adults were taken on the leaves of tobacco in Mauritius in April 1938. The author reiterates his opinion that *B. gossypiperda*, Misra & Lamba, and *B. hibisci*, Takah., are synonyms of this species [*cf. R.A.E.*, A **25** 305].

PINTO (M. P. D.). **Trials with the Indian Lac Insect in Ceylon during 1938–1939.**—*Trop. Agriculturist.* **94** no. 2 pp. 79–89. Peradeniya, 1940.

Attempts to cultivate the Indian lac insect, *Laccifer lacca*, Kerr, in Ceylon have been unsuccessful owing to heavy larval mortality following degeneration of the stock shortly after the introduction of brood lac from India and to natural enemies. The devitalisation of the stock was not thought to be due entirely to unfavourable climatic conditions, since a similar mortality occurs in parts of India where the climate is known to be favourable, and the factors causing it were therefore investigated during 1938 [*R.A.E.*, A **28** 563] and 1939.

These trials, a detailed account of which is given, established that *L. lacca* can develop in the climate of the lower altitudes, in some parts of which, particularly the dry areas, the food-plant, *Schleichera trijuga*, occurs naturally. The life-cycle, which lasts about 6 months in India, varies from 5 to 6 months in Ceylon, depending on weather conditions, and the emergence of the larvae is not confined to January–February and June–July, as in India, but takes place at irregular intervals and may occur in any month.

Larval mortality was considerably reduced by cutting the brood lac 3–6 days after the larvae had begun to emerge, instead of before emergence started, when they are prematurely deprived of nourishment through the parent female, or by allowing them to swarm naturally on the originally infested tree. Crops on naturally infested trees did not appear to be more severely attacked by natural enemies than those resulting from artificial distribution of brood lac. In most districts, natural enemies [*cf.* **24** 103], notably *Eublemma amabilis*, Moore, and *Holcocera pulverea*, Meyr., caused heavy mortality after the first two crops, and their numbers increased with each successive crop, since the climate provides no natural check such as occurs to some extent in northern India. An ant of the genus *Crematogaster* attacked the larvae soon after they had settled on the trees.

It is concluded that, in general, only two successive crops can be successfully raised in one locality in Ceylon, and that this should then be abandoned for a season so that lack of food may reduce the natural enemies ; the third crop should be raised in another locality at some distance from the first. It is doubtful whether such a scheme would be practicable among the native cultivators, and in view of the small local demand for shellac and seed lac and the decline in prices abroad, it is concluded that lac cultivation in Ceylon offers little promise of success.

Kannangara (A. W.). **Bee-Keeping—The Wax Moth.**—*Trop. Agriculturist* **94** no. 2 pp. 94–98, 2 pls., 3 refs. Peradeniya, 1940.

Galleria mellonella, L., which is of world-wide distribution, reaches its greatest importance in Ceylon and the plains of southern India, where it enters hives of the indigenous honey-bee (*Apis indica*, F.) and destroys the cells to such an extent that the bees abandon the hives.

In Ceylon, outbreaks occur in neglected hives at altitudes up to 2,500 ft. In breeding-cages in the laboratory, females deposited an average of 688 eggs in masses of 200–300 in crevices, sometimes extremely narrow, but did not oviposit in fresh combs. The newly-hatched larvae move about actively until they reach a sheltered position near the base of the combs and then disintegrate the cells and tunnel in the septum between the two layers. They cause no direct injury to any stage of the bees. Newly-vacated combs containing propolis and pollen are preferred, pure wax and honey not being attacked to any great extent. The first indication of the presence of the larvae is provided by the silken web with which they cover themselves, and later the black excreta become apparent. Within a fortnight the comb is pulverised and the cells completely disintegrated. When full-fed, the larvae construct silken cocoons near the septum or in sheltered parts of the comb ; the cocoons are often covered with frass, and 4 or 5 may be webbed together. The adults, which live for about 8 days, are active by night ; females begin to oviposit on the day after

emergence, but most of the eggs are deposited on the second or third day. The egg, larval and pupal stages last 7–9, 30–40 and 8–9 days, respectively.

Infestation usually begins in June, soon after the first flow of honey, when the hives are weakened after swarming, and combs that cannot be utilised by the bees should therefore be temporarily removed at this time. The risk of its occurrence is increased by the presence of jungle swarms. Hives should be constructed of seasoned timber, with well-fitting joints that will not provide oviposition sites. The entrance should be small ($\frac{1}{4}$ in. high and $2\frac{1}{2}$ ins. long) to prevent the larvae from entering the hive unnoticed by the bees, and strong colonies should be maintained so that any that succeed in entering may be discovered and destroyed. If infestation is suspected, the hives should be carefully examined at regular intervals, and cracks, bad joints and the spaces between the brood-box and super, and the super and roof, thoroughly cleaned with a hard brush. The damaged portions of combs attacked by *G. mellonella* should be removed, and pieces of comb should not be thrown down near the hives, since they attract the moths.

François (E.). **Un ennemi du giroflier à Madagascar.**—*Rev. Bot. appl.* **20** no. 222 pp. 116–117. Paris, 1940.

A Cossid of the genus *Xyleutes*, tentatively identified as *X. cretaceus*, Btlr., has caused considerable damage to clove trees in eastern Madagascar. The larvae make galleries over a foot long in the wood of the branches and trunks, sometimes killing the entire tree. The galleries of several larvae may join to form tunnels as much as 6 ft. in length. The infestation has spread during the last six years, more than 20,000 trees being more or less seriously injured, and control measures have therefore been enforced. The only effective method of control appears to be to lop off the infested branches below the point of attack and burn them immediately to kill the larvae and pupae.

Annet (E.). **Note sur les dégâts causés aux bananiers par l'***Heteronychus claudius***.**—*Rev. Bot. appl.* **20** no. 222 pp. 119–121. Paris, 1940.

In view of a statement that damage in 1936 to the roots of bananas in French Guinea [*cf. R.A.E.*, A **25** 363] was not caused by *Heteroligus* (*Heteronychus*) *claudius*, Klug, but by a Nematode of the genus *Anguillulina*, the author records observations made over several years confirming that it was the Dynastid that was responsible. The first large-scale attack occurred in January 1936, on bananas on soil that was rich in humus and had previously borne *Raphia humilis*. Entire rows of bananas became discoloured and wilted in a few days, and larvae were found round the roots, which were injured in the most tender parts near the pseudostem. Injury is caused only by larvae about to pupate, and this period of activity lasts 15–20 days. In 1936, hand collection was the only method of control, but in 1937, when the injury was less severe, powdered calcium sulphide was hoed into the soil. No immediate results were apparent, owing to lack of soil moisture, but it is concluded that sulphur dioxide was liberated when rain fell in April and May, and killed the emerging adults. Very few adults were observed in treated areas in 1938, and damage was slight.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **51** pt. 3 pp. 150–154, 9 figs. Sydney, 1940.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **28** 564] includes notes on *Megacoelum modestum*, Dist., which is the Capsid recently recorded as *Dicyphus* sp. [*cf.* **27** 449]. It caused considerable injury to beans in the Gosford district in 1936 and 1939, and produces the condition known as blind eye, in which the buds developing on the flowering branches become dry and fall off. The damage is normally confined to October and November. The bugs also fed on the growing tips of passion vines [*Passiflora edulis*] in this district and were taken on pome and stone fruits, being often associated with *Nysius vinitor*, Bergr. Both species caused considerable damage to peaches at Bathurst as late as January 1940. *M. modestum* is present on apple about the time of blossoming, usually in association with a smaller species, and has been considered a possible cause of the malformation of the fruits of certain varieties that has occurred during several seasons. For control, excellent results have been given by a $2\frac{1}{2}$ per cent. emulsion of kerosene in which pyrethrum powder has been steeped (1 lb. to 1 gal.). A predacious Reduviid is usually associated with *M. modestum* and may account for the fact that damage by the latter is limited to a brief period of the year.

Injury to wild and cultivated ferns is caused by larvae and adults of the weevils, *Syagrius fulvitarsis*, Pasc., and *Neosyagrius cordipennis*, Lea. Brief notes are given on the life-history of *S. fulvitarsis* in Hawaii [*cf.* **9** 469]. *N. cordipennis* is apparently confined to maidenhair fern (*Adiantum*); its life-history, so far as it is known, is somewhat similar to that of *S. fulvitarsis*. Control of these weevils can sometimes be effected by spraying or dusting with lead arsenate to kill the adults and by hand-picking or the removal of fronds infested by the larvae, but if infestation is heavy, the destruction of the fern may be necessary.

Fell (H. B.). **Economic Importance of the Australian Ant,** *Chalcoponera metallica*.—*Nature* **145** no. 3679 p. 707, 2 refs. London, 1940.

Notes are given on the habits of *Chalcoponera metallica*, F. Sm., based on observations in southern Queensland in the winter of 1939. This ant is almost exclusively predacious, and it attacks a number of agricultural pests. The nests consist in irregular galleries excavated in the earth under grass roots, stones or logs. The examination of three colonies indicated that Lepidopterous, Coleopterous and Dipterous larvae constituted 77·5 per cent. of the food of these ants, while small Arachnids, adult Microlepidoptera and other insects represented 11·2, 6·8 and 4·5 per cent., respectively. From figures showing the average collection of a single colony per day, which probably represent a minimum rather than an average for the year, it is estimated that a colony of only a few hundred ants destroys over 45,000 grubs annually.

Froggatt (J. L.). **The Sweet Potato Hawk Moth,** *Hippotion celerio*.—*New Guinea agric. Gaz.* **5** no. 3 pp. 2–3. Rabaul, 1939. [Recd. 1940.]

Very brief notes are given on the life-history of *Hippotion celerio*, L., which in dry weather is a serious pest of sweet potatoes in the Territory

of New Guinea [*cf. R.A.E.*, A **24** 467], and occasionally attacks taro (*Colocasia* spp.) and *Caladium*. Eggs of this Sphingid are laid on the foliage and hatch in 3–4 days. The larvae, which feed on the lower surface of the leaves, are parasitised by the Tachinid, *Zenillia* (*Carcelia*) *kockiana*, Tns., and are also destroyed by the nymphs and adults of the Pentatomid, *Platynopus melacanthus*, Boisd. The giant toad, *Bufo marinus*, has been introduced against this and other pests. Sprays of lead arsenate (1 lb. to 50 gals. water) or dusts of 10 per cent. lead arsenate or calcium arsenate, applied as soon as eggs or larvae are observed, give effective control. Three applications at intervals of ten days are usually sufficient in fine weather, but further treatments are required after heavy rain. The adults are attracted to light, and instructions are included for making a simple light-trap.

DA COSTA LIMA (A.). **Especies de *Pseudococcus* observadas no Brasil. (Homoptera : Coccoidea-Pseudococcidae.)** [Species of *Pseudococcus* observed in Brazil.]—*Bol. biol.* **4** (N.S.) no. 1 pp. 1–10, 1 pl., 2 pp. refs. S. Paulo, 1939. (With a Summary in English.) [Recd. 1940.]

A key is given to the more important Brazilian species of *Pseudococcus*, together with notes on their food-plants and, in some cases, their systematic position. *P. joannesiae*, sp. n., is described from the adult female taken on *Joannesia princeps* in the State of Rio de Janeiro. Examination of type material in São Paulo showed that *P.* (*Dactylopius*) *setosus*, Hemp. [*cf. R.A.E.*, A **13** 197] is a synonym of *Ferrisiana virgata*, Ckll.

MACLEOD (G. F.). **Some quantitative Aspects of Insect Injuries to Potato Plants.**—*Amer. Potato J.* **16** no. 7 pp. 179–184, 1939. (Abstr. in *Exp. Sta. Rec.* **82** no. 3 pp. 356–357. Washington, D.C., 1940.)

Investigations in New York State over a period of 5 years on potato spraying and dusting in an attempt to produce a larger high-quality yield indicated a need for detailed quantitative measurements of the complex relationships between plant, organism and spray material. The insect population of potato plants in New York comprises several species under normal field conditions, while differences in tuber yields suggest that some species are more injurious than others, although present in smaller numbers. Variations in comparatively small numbers of leafhoppers [*Empoasca fabae*, Harr.] and tarnished plant bugs [*Lygus pratensis*, L.] were more closely correlated with variations in tuber yield than were variations in larger numbers of flea-beetles [*Epitrix cucumeris*, Harr.] and potato Aphids [*Macrosiphum solanifolii*, Ashm.].

ALLEN (T. C.) & RIEMAN (G. H.). **Occurrence of Hopperburn Resistance and Susceptibility in the Potato.**—*Amer. Potato J.* **16** no. 6 pp. 139–142, 1939. (Abstr. in *Exp. Sta. Rec.* **82** no. 3, pp. 358–359. Washington, D.C., 1940.)

Investigations made during the seasons of 1937 and 1938 in southern Wisconsin confirmed the observation that potatoes vary in susceptibility to the hopperburn [caused by *Empoasca fabae*, Harr.], early-maturing varieties proving more susceptible than late-maturing ones.

By selecting injured and uninjured individuals when segregating seedling populations grown under epidemic conditions in the field, it was possible to separate segregates into two distinct levels of hopperburn tolerance. A number of seedling cultures were isolated that showed a greater degree of resistance and of susceptibility to hopperburn than any of the new or old varieties tested. Relative percentage hopperburn resistance and susceptibility were based on the ratio of necrotic hopperburn tissue to healthy green tissue that occurred in the leaf tissues examined.

Later than customary Poisoning of Boll Weevils indicated as profitable in Cotton Production.—*Miss. Farm Res.* **2** no. 10 p. 7, 1939. (Abstr. in *Exp. Sta. Rec.* **82** no. 3 p. 365. Washington, D.C., 1940.)

Work in Mississippi has indicated that a dust of undiluted calcium arsenate gives much better control of the cotton boll weevil [*Anthonomus grandis*, Boh.] and the cotton leaf worm [*Alabama argillacea*, Hb.] than a mixture of equal parts of calcium arsenate and hydrated lime ; but it is thought that where the cotton flea-hopper [*Psallus seriatus*, Reut.] and the weevil are both abundant, a mixture of calcium arsenate and sulphur (1 : 2) would be of greater value. Plants stripped of fruit until just before the maximum fruiting period, or until 10th–15th July, and then dusted produced a better crop each year than plants that were protected throughout the season. Plants should be left until they are large and fruiting heavily before infestation counts are made, and if 10–25 per cent. of the squares on fruiting plants are being punctured about the first week in July, three applications of calcium arsenate should be made.

Wilbur (D. A.) & Fritz (R. F.). **Grasshopper Populations (Orthoptera, Acrididae) of typical Pastures in the Bluestem Region of Kansas.**—*J. Kans. ent. Soc.* **13** no. 3 pp. 86–100, 1 graph, 16 refs. Manhattan, Kans., 1940.

To determine the composition and fluctuations of the Acridid fauna of the Flint Hills region of Kansas, sweepings with a net were made throughout the growing seasons of 1933–39 in three representative types of pastures, namely, the native prairie, on which bluestone grass (*Andropogon* spp.) predominates, and pasture land consisting mainly of Kentucky bluegrass (*Poa pratensis*) or orchard brome (*Bromus*), the floristic composition of which is described. The period of investigation coincided with the hottest and most severe drought recorded in Kansas.

Bar graphs show the numbers and seasonal distribution of nymphs collected each year. The nymphs were most numerous in 1933, before the serious drought set in, and least abundant in 1935, probably owing to excessive rains and low temperatures in May and June. In 1934, in addition to the normal peak of nymphal abundance in June, there was another one in September–October, for a second generation of *Melanoplus mexicanus*, Sauss., hatched in early September, when rains broke a drought that had lasted for $3\frac{1}{2}$ months.

In 1933 and 1934, the grasshopper population was much greater in the native prairie than in the other two types of pasture, but in 1936 to 1938 the situation was reversed. The 33 species of which adults were

taken and the numbers of the latter are shown in a list ; about 68 per cent. of the total number of individuals taken consisted of *Orphulella* spp., *Ageneotettix deorum*, Scudd., *M. mexicanus* and *M. bivittatus*, Say. The studies confirmed the differences between the composition of the Acridid fauna in native grasslands and crops, emphasised in earlier literature, which is reviewed. They also confirmed that the genera *Orphulella* and *Mermiria* dominate the populations in native prairie [*cf. R.A.E.*, A **25** 680], although during the most severe drought the numbers of *Melanoplus* spp. tended to increase and those of *Orphulella* spp. to decrease. The Kentucky bluegrass and orchard-brome pastures are dominated by *Melanoplus* spp. and *A. deorum*.

LANGE jr. (W. H.). *Anystis agilis* **Banks, a Predacious Mite on Eggs of the Artichoke Plume Moth.**—*Pan-Pacif. Ent.* **16** no. 1 p. 30. San Francisco, 1940.

It is stated in this note that the mite, *Anystis agilis*, Banks, is common on globe artichoke in the Half Moon Bay area of California and feeds on newly laid eggs of the artichoke plume moth, *Platyptilia carduidactyla*, Riley. It also attacks Collembola and the artichoke aphis, *Capitophorus braggi*, Gillette.

CUSHMAN (R. A.). **New Genera and Species of Ichneumon-Flies, with taxonomic Notes.**—*Proc. U.S. Nat. Mus.* **88** no. 3083 pp. 355–372, 2 figs., 4 refs. Washington, D.C., 1940.

Two new genera and nine new species of Ichneumonids are described, the latter including *Cryptohelcostizus chrysobothridis*, bred from *Chrysobothris* sp. on apple in Oklahoma, *Ephialtes* (*Calliephialtes*) *ferrugineus*, from *Platyedra* (*Pectinophora*) *gossypiella*, Saund., in Porto Rico, and *Idechthis peruviana*, from *Mescinia peruella*, Schaus, in Peru. *Cryptoideus bituminosus*, Cushm. [*cf. R.A.E.*, A **12** 137] is transferred to the genus *Hoplocryptus* and recorded from *Pyrausta nubilalis*, Hb., in Massachusetts and Connecticut, *P. penitalis*, Grote, in Ohio, *P. ainsliei*, in Indiana and Ohio, and *Diatraea* sp. in Louisiana. *Cryptohelcostizus alamedensis*, Ashm., of which *C. rufigaster*, Cushm. [*cf.* **7** 376 ; **9** 29] is a synonym, was bred from *Chrysobothris mali*, Horn, and other Buprestids in California. Ashmead's record of this parasite from an unidentified Lepidopterous host is rendered doubtful by the fact that all other reared examples have been parasites of Buprestid larvae. The examination of material from North America and Europe showed *Pimpla ovalis*, Thoms. [*cf.* **21** 119] to be a synonym of *Pimpla* (*Itoplectis*) *atrocoxalis*, Cress.

CHARLES (V. K.). **Notes on Entomogenous Fungi.**—*Plant Diseases Reporter* **23** no. 21 p. 340, 1939. (Abstr. in *Rev. appl. Mycol.* **19** pt. 4 pp. 213–214. Kew, 1940.)

The entomogenous fungi recorded [*cf.* also *R.A.E.*, B **28** 237] include *Fusarium* sp. and *Beauveria globulifera* from *Cylas formicarius*, F. (sweet potato weevil) in Georgia and Mississippi, respectively, and *Empusa fresenii*, in the conidial and resting spore stages, from *Periphyllus lyropictus*, Kessler, a serious pest of *Hydrangea arborescens* in New Hampshire.

Service and Regulatory Announcements, January-June, 1940.—*S.R.A., B.E.P.Q.* nos. 142–143 pp. 1–38, 39–63. Washington, D.C., U.S. Dep. Agric., 1940.

Administrative Instructions (B.E.P.Q. 499 supplement no. 1 revised) relating to Quarantine no. 48 against the Japanese beetle [*Popillia japonica*, Newm.] (pp. 8–9) authorise the fumigation with methyl bromide by a method already described [*R.A.E.*, A **27** 591] of plants with bare roots or in pots or soil balls up to 12 ins. in diameter at temperatures not lower than 63, 54 or 50°F. for periods of $2\frac{1}{2}$, 4 or $4\frac{1}{2}$ hours, respectively. The schedule for strawberry plants [**26** 384] remains unaltered. A revised list (B.E.P.Q. 394 revised) of true bulbs, corms and tubers exempt from requirements of certification [*cf.* **24** 803] is given (pp. 51–52). Administrative Instructions (B.E.P.Q. 499 supplement no. 2) (pp. 56–57) authorise the fumigation with methyl bromide of specified fruits and vegetables in refrigerator cars by a method already described [**26** 751] at temperatures of 80 or 70°F. with dosages of 1·6 lb. per 1,000 cu. ft. space (4 lb. per car) or 2 lb. per 1,000 cu. ft. space (5 lb. per car), respectively. With the lower dosage, 2 lb. must be applied at each end of the car ; but with the higher one, 3 lb. must be applied at the end opposite the electric blower, and 2 lb. at the other end.

An announcement relating to Quarantine no. 58 against pests of fruit and vegetables in Porto Rico (pp. 9–11) includes Administrative Instructions (B.E.P.Q. 505) authorising the shipment from Porto Rico into the United States of oranges and grapefruits that have been treated under supervision against *Anastrepha suspensa*, Lw., by the application of heat at a relative humidity of 100 per cent. for not less than 16 hours, during which the temperature at the approximate centres of the fruit must be 110°F. or higher for the last 8 hours of the treatment, or by cooling until the temperature at the approximate centres is 34°F. or lower and maintaining it for 15 days [*cf.* **26** 325]. Suggestions, based on experiment, on methods of application (B.E.P.Q. 506) are also given. Dry heat at the required temperature is injurious to the fruit, which may also be damaged by temperatures much above 110°F., but successful results were obtained when live steam was applied in such a manner as to secure a uniform distribution of steam-heated air, introduced into the treating chamber so that it did not discharge directly on to the fruit, and the air temperature increased with that of the fruit, gradually and at a uniform rate, until it reached 110°F. At no time should it exceed 112°F. The fruit should be well cooled before packing, and if it is to be coloured by the use of gas, this should be done before treatment ; wax or paraffin should not be used on the fruit. The cold treatment can be successfully applied in cold storage chambers only when they are provided with adequate refrigeration and positive, uniform circulation of the cooled air ; when they are properly equipped and operated, the required temperature can be maintained in them with variations of 2°F. or less.

Administrative Instructions (B.E.P.Q. 503 revised) relating to Quarantine no. 72 against the white-fringed beetle (pp. 12–13) modify the treatment of nursery stock in soil balls with a solution of methyl bromide and ethyl alcohol [**28** 490] against larvae of *Pantomorus leucoloma*, Boh., but not against those of *P. peregrinus*, Buchanan, which occurs at Gulfport and certain other points in Mississippi. The treatment of soil balls not exceeding 7 ins. in diameter is now

authorised against *P. leucoloma*, provided that their temperature during treatment is not lower than 65°F., and that they remain embedded in sand for 8 hours after the required dosage has been applied.

A circular (B.E.P.Q. 508 superseding B.E.P.Q. 461) (pp. 15–23) shows which of the circulars containing information on the Federal plant quarantines that have been issued since 18th January 1915 are valid and which are obsolete. Other information in these parts includes summaries of plant quarantine restrictions in the British Isles (pp. 23–35) and amendments to summaries already noticed of restrictions in British India (p. 23), the Union of South Africa (p. 36) and Cuba, Egypt, Mexico and Paraguay (pp. 60–61).

SASSCER (E. R.). **Undesirable Insect Aliens.**—*J. econ. Ent.* **33** no. 1 pp. 1–8, 16 refs. Menasha, Wis., 1940.

This presidential address deals with the introduction of insect pests from foreign countries into the United States. Attention is drawn to the failure of the people to perceive the need for controlling the entry of insects until recent times, and the increased danger that resulted from the development in the nineteenth century of faster and larger ships with facilities for refrigeration. Representative lists are given of insects that were introduced during the nineteenth and twentieth centuries, and quarantine measures to hinder their entry since the first bill was introduced in 1892 are briefly reviewed. It is pointed out that in view of the large diversity of crops grown in the United States and the geographical zones involved, there are few insects that could not thrive in some part of the country. The annual financial loss caused by introduced insects is discussed. Figures are quoted to show the large number of interceptions made at United States ports, lists of some of the species intercepted are given, and attention is drawn to the possibility of insects that are not pests in their native country becoming serious ones when introduced into another, and to the need for greater knowledge of foreign insects among economic entomologists. Other aspects of the problem dealt with are the difficulty of identifying immature stages, the treatment of infested shipments, the increased danger through transport by air and the possibility of plants and plant products in a less satisfactory condition than usual being despatched from countries at war. It is suggested that a three-fold defence against foreign pests, consisting of a group of entomologists abroad to ascertain facts in the countries in which there are pests that it is desired to exclude, the port inspection service, and a prepared plan of action for dealing with an incipient infestation, would increase the possibility of keeping the country free of foreign insect pests.

Symposium on Fifty Years of Entomological Progress.

MARLATT (C. L.). **Part I, 1889 to 1899.**—*J. econ. Ent.* **33** no. 1 pp. 8–15. Menasha, Wis., 1940.

CAESAR (L.). **Part II, 1899 to 1909.**—*T.c.* pp. 15–21.

METCALF (C. L.). **Part III, 1909 to 1919.**—*T.c.* pp. 21–30.

ESSIG (E. O.). **Part IV, 1919 to 1929.**—*T.c.* pp. 30–58, 15 pp. refs.

ROHWER (S. A.). **Part V, 1929 to 1939.**—*T.c.* pp. 58–65.

The first of these papers deals with the decade following the foundation of the American Association of Economic Entomologists, the first meeting of which was held on 30th August 1889. A brief

account arranged chronologically is given of the important insects, both useful and harmful, that were introduced into the United States or otherwise came to notice during this period. Biological control, which was first artificially practised with success in 1889, and the advancement of insecticides, principally the arsenicals, lime-sulphur, creosote oil and hydrocyanic acid gas, are discussed. Accounts are given of the three outstanding new pests of the period, the gipsy moth, *Lymantria* (*Hypogymna*) *dispar*, L., the cotton boll weevil [*Anthonomus grandis*, Boh.] and the San José scale [*Aspidiotus perniciosus*, Comst.]. The paper concludes with the statement that the most significant point of the decade was the attitude of " quarantine consciousness " and " eradication consciousness " that became general towards its close.

During the next 10 years, considerable progress was made in training men as professional entomologists. Accounts are given of the valuable results obtained in the campaigns against *L. dispar*, *Anthonomus grandis* and *Aspidiotus perniciosus*, and the progress made in the study of forest insects as a State project is recorded. The concluding paragraphs deal with the advance of entomology in Canada, where the problems involved were less urgent.

The third decade includes the World War of 1914–18. Its stimulating effect on entomology, particularly the control of pests of stored food and clothing and wood-boring beetles, the development of insecticides to replace lead arsenate, in view of the fact that arsenic was required in the manufacture of munitions, and extension work are noted and discussed. The war was followed by an entomological depression. A list is given of some foreign pests that were first discovered in the United States during the period, and of the economic problems that received most attention. The outstanding advances in chemical control, the development and improvement of spraying and dusting machinery and equipment, the advance in biological control and legislation and the efficiency of extension work are noted. The first effective work of entomologists on the insect transmission of plant diseases was done at this time, and resistance of insects to insecticides and of plants to insects was noticed. The importance of " pure science " and its many applications to economic entomology was appreciated. Co-operation improved greatly, and the First International Congress of Entomology was held at Brussels in August 1910. Lists are given of the entomological text-books available at the beginning of the decade, the many published in the course of it and the periodicals begun. In conclusion, a list is given of entomologists publishing actively during the period, showing the subject on which each worked.

The review of entomological progress during the years 1919–1929, which comprises the fourth part, takes the form of a review under various headings of the literature published by North American workers. A long and valuable bibliography of the works cited in the text is appended. The headings include Systematic Entomology, Anatomy and Physiology, The most important Insect Pests, Forest Entomology, Biological Control, Insects in Relation to Plant Diseases, Insect Toxicology, Residues, and Miscellaneous Control Practices. Lists are given of foreign insects introduced and of new serial publications.

In the final paper, it is stated that economic, political and climatic considerations had an important and significant bearing on entomology during 1929–39. New policies of control were developed, and research

achieved noteworthy results, which were put into practice commercially. Economic entomology gained increasing recognition, and greater cooperation among entomologists was attained. The discovery and eradication of the Mediterranean fruit-fly [*Ceratitis capitata*, Wied.] in Florida, and increased knowledge on the control of the codling moth [*Cydia pomonella*, L.] are reported. The problem of spray residues received much attention and led to much research on organic insecticides. More money was expended for work on insects than during any similar period in the history of the United States. There was a concerted effort to make available to the public information on insects and the work of entomologists, and an account is given of the ways in which this was done. Research work increased, largely along new lines, and 50 examples are given of subjects studied.

LANGE jr. (W. H.). **Tests with Methyl Bromide as a Fumigant for Larvae of the Artichoke Plume Moth.**—*J. econ. Ent.* **33** no. 1 pp. 66–69, 4 figs., 8 refs. Menasha, Wis., 1940.

An account is given of tests in California in 1937–38 of methyl bromide as a fumigant against larvae of *Platyptilia carduidactyla*, Riley, in planting stock of globe artichoke, on which they are, for the most part, borers in the stems or leaf petioles. In replanting, it is customary to use either a part of the main plant with a central stem or a succulent offshoot, with the result, especially in the latter case, that the Pterophorid is spread in infested material. As *P. carduidactyla* is widely distributed on *Cirsium* thistles in California, the use of uninfested planting stock in new artichoke-growing areas would not in itself prevent infestation, but it would help to prevent or delay it where the thistles had been properly destroyed. Methyl bromide in vacuum fumigation tests was found to cause practically complete mortality of the larvae within the plants at dosages of 1½–2½ lb. per 1,000 cu. ft. with an exposure of 90 minutes and an initial vacuum of 20–27 inches mercury. No immediate injury to the plants was observed after treatment, but in 10–20 days a noticeable retardation of growth was recorded, and death often followed. The injury to the plants was not regarded as being of a mechanical nature, but rather chemical or physiological. A delayed mortality of the larvae occurred in certain cases, death taking place in 2–14 days. The most satisfactory treatment giving a high mortality of larvae with minimum injury to the plants was vacuum fumigation with a reduced dosage of 1 lb. methyl bromide per 1,000 cu. ft. and an exposure of 2–2½ hours at a temperature of 72–76°F.

Several tests were made of fumigation at atmospheric pressure with different dosages and periods of exposure, and in all cases a perfect kill of larvae was obtained; such treatment, however, is not recommended, as the exposures required caused increased injury to the plants.

MORRISON (H. E.). **Seasonal History of Hop Pests on Oregon Hops during 1938.**—*J. econ. Ent.* **33** no. 1 pp. 70–71, 3 figs. Menasha, Wis., 1940.

The seasonal development of *Tetranychus telarius*, L., and *Phorodon humuli*, Schr., on hops was studied at Corvallis, Oregon, in 1938 by

making population counts at intervals of 10 days from the time the pests were first observed. Ten leaves were selected at random from each of over 4,500 hop vines, and the percentage of leaves infested and the numbers of mites or Aphids per leaf were counted or estimated as accurately as possible. The population density of *T. telarius* on hops is normally highest during the latter part of September, but in 1938, when the summer was hot and dry, the peak occurred early in August, and the mite had practically disappeared from unsprayed plants by the middle of September, when the hops were harvested. The reduction in their numbers was probably due to predators ; *Chrysopa californica*, Coq., *Hippodamia convergens*, Guér., *H. parenthesis*, Say, and *H. oregonensis*, Crotch, were found in considerable abundance feeding on both *T. telarius* and *P. humuli*. All the leaves of a one-year-old hop plant in a corner of the experimental plot were infested by *T. telarius* from very early spring until 29th July, after which the percentage infested declined steadily to 20 in about three weeks. The numbers of mites reached a maximum by 19th July, after which they declined rapidly. The plant was treated with an oil spray on 2nd August, when the reduction in the percentage of leaves infested had already begun. Small numbers of spring migrants of *P. humuli* were first noted on hop foliage on 23rd May, and a slight increase in population density occurred in the latter part of June, but after this the Aphids were controlled by predators, and very few were present at harvest. They normally reach their peak of abundance at this time, and the secretion of honeydew promotes the development of sooty mould (*Cladosporium* sp.) and lowers the market value of the crop.

Three species of thrips, *Aeolothrips melaleucus*, Hal., *Thrips tabaci*, Lind., and *Frankliniella moultoni*, Hood, were taken in the hop garden on 30th July. *A. melaleucus*, which has not previously been recorded from the United States, but has been observed to be predacious on *T. telarius* in Canada, was present in only small numbers. Decided silvering of the hop foliage in 1938 was attributed to one or both of the other two thrips, and it is also thought that they may be the cause of the reddening or russetting of the immature hop clusters that is commonly considered to be due to moisture or fertiliser factors. Both species are known vectors of virus diseases and may contribute to the virus-like symptoms sometimes observed in hops in the Willamette valley. *F. moultoni* is common in California, but has not previously been taken in Oregon.

The larvae of *Cnephasia longana*, Haw., frequently destroy the terminal buds of hops near flax fields. The development of lateral shoots at the points of injury increases the cost of stringing the vines. The larvae of *Nymphalis antiopa*, L., which have occasionally been observed feeding on nettles, were taken on hops, apparently for the first time. This is considered to be a chance occurrence, but 10 plants were completely defoliated before the larvae were exterminated.

GRAY (K. W.) & SCHUH (J.). **Pea Aphid Control Experiments in Oregon.**—*J. econ. Ent.* **33** no. 1 pp. 72–77, 1 fig. Menasha, Wis., 1940.

Experiments on the control of the pea aphis [*Macrosiphum onobrychis*, Boy.] were carried out in Oregon in 1936–38. The results

reported in this paper are principally those obtained during 1938, when only dusts were used. All applications were made by means of hand dusters on trellis peas in plots, the arrangement of which is described. Populations were measured by counts of Aphids on plant tips; 5 counts were made on each plot during the season.

The insecticides used included rotenone, nicotine sulphate, pyrethrum and Loro (50 per cent. aliphatic thiocyanates, 40 per cent. fatty acid sulphonates and 10 per cent. water). Hydrated lime was used as the carrier for the nicotine sulphate and talc for the other insecticides. Vatsol OS (a practically pure sodium salt of an alkyl naphthalene sulphonic acid) was used as a wetting agent in some of the dusts. The dusts were applied at the rate of 20 lb. per acre for the first application, on 28th July, when the plants were 8–14 ins. tall, and 40 lb. per acre for the two subsequent applications on 14th and 25th August. The more effective of them gave about 90 per cent. control.

Dusts containing 0·75 per cent. rotenone and 4 per cent. castor, coconut, cotton-seed, ground-nut, olive or neats foot oil were as effective as the best of the other dusts and would cost less. Dusts containing the same proportion of rotenone and 3 per cent. of the wetting agent gave inferior control, as also did that containing 2 per cent. nicotine sulphate. Both the combination of rotenone and wetting agent with the addition of pyrethrum stems (0·0105, 0·0205 and 0·042 per cent. pyrethrins in the mixed dust) and dusts containing 0·5 or 0·75 per cent. rotenone with 2 per cent. Loro gave good kills, and, in general, gave significantly better control than the dust containing rotenone and wetting agent only, but were more expensive. The dusts containing Loro caused slight scorching of the plant tips.

Tests in 1937 and 1938 indicated that the most efficient rate of application of a dust containing 0·75 per cent. rotenone and 3 per cent. wetting agent was about 60 lb. per acre, while work in 1936 and 1937 showed that satisfactory control could be obtained on peas grown on trellises by the use of a spray containing rotenone (1 : 10,000) with a wetting agent and fish-oil soap applied at about 300 U.S. gals. per acre. The spray tested consisted of 2 lb. cubé, 1½ lb. Aresket 240 and 2 lb. fish-oil soap in 100 U.S. gals. water.

MILUM (V. G.). **Larval Pests common to Nests of Bumblebees and Combs of the Honeybee.**—*J. econ. Ent.* **33** no. 1 pp. 81–83, 9 refs. Menasha, Wis., 1940.

The author records the finding of larvae of *Vitula edmandsii*, Pack., in neglected honey-bee combs in Kansas in 1935 [*cf.* also *R.A.E.*, A **10** 125], and in a nest of the bumble-bee, *Bombus impatiens*, Harr., in Indiana in 1938. He considers it probable that the larvae of this Pyralid, like those of *Ephestia kuehniella*, Zell., and *E. cautella*, Wlk., feed on the stored pollen and only incidentally attack the comb and wax. He has found that though *Galleria mellonella*, L., *Achroia grisella*, F., and *Plodia interpunctella*, Hb., can reproduce on the refuse of honey-bee brood combs, with or without pollen, *E. kuehniella* and *E. cautella* cannot be reared on brood comb when such sources of protein as pollen and dead insects are removed, though thriving cultures can be maintained in combs containing pollen. From a review of the literature, he concludes that honey-bee combs and the nests of bumble-bees are both infested by *P. interpunctella*, *E. kuehniella*

and possibly also by *A. grisella*, *G. mellonella* and *E. cautella*, which are known to occur in honey-bee combs, and by *Aphomia sociella*, L., which is widely distributed in the nests of bumble-bees.

Woglum (R. S.) & Lewis (H. C.). **Whitewash to control Potato Leafhopper on** *Citrus*.—*J. econ. Ent.* **33** no. 1 pp. 83–85, 3 refs. Menasha, Wis., 1940.

For several years, injury in the form of a rind spot on oranges maturing during late autumn and winter has been of increasing importance in central California, and field observations in 1936–38, confirmed by cage tests in 1938, showed that this was due to the feeding punctures of *Empoasca fabae*, Harr. During the summer of 1938, *E. fabae* was found breeding on cocklebur [*Xanthium*] and sunflower, which are common weeds in this region, and during October and November, when the weather was cooler and the food-plants were drying up, the adults migrated to *Citrus*. They congregated on exposed fruits throughout the winter when the weather was favourable. Navel oranges are most severely damaged in autumn, and the later-ripening Valencia variety in winter.

Attempts to control the leafhoppers by means of pyrethrum sprays or dusts or Cyanogas calcium cyanide broadcast under the trees at the rate of 40 lb. per acre were unsuccessful. Pyrethrum, rotenone, sulphur and compounds of copper and zinc, applied in dusts or sprays, appeared to have no repellent action, but a spray of tetramethyl thiuram disulphide (4 lb. per 100 U.S. gals.) showed some promise. A dust of hydrated lime was unsatisfactory as it did not make the trees white enough [*cf. R.A.E.*, A **25** 692] and it weathered rapidly. Good results at a low cost were given, however, by coating the whole of the outside of the tree with a whitewash consisting of 150 lb. hydrated lime (later reduced to 100 lb.), 25 lb. zinc sulphate and 12 oz. blood albumin spreader in 300 U.S. gals. water, which improved the yield of first-grade Valencia oranges in a small grove by 37 per cent. The inclusion of zinc is of additional benefit in the control of mottle-leaf and the stimulation of tree growth. New growth and the setting of the new crop appeared to be normal, and the mature fruit could be cleaned satisfactorily.

Smith (R. H.). **Rating Thoroughness of Application in spraying** *Citrus* **Trees.**—*J. econ. Ent.* **33** no. 1 pp. 85–91. Menasha, Wis., 1940.

The following is substantially the author's summary of work in California in 1931–32 : In experiments with various oil sprays for the control of *Saissetia oleae*, Bern., on *Citrus*, the range in degree of thoroughness of spray application was found to be as great as the range in killing values among the sprays tested. Thoroughness of application was evaluated in three ways, by examining clusters of leaves, fruits and twigs immediately after spraying, to determine whether uncovered parts were present ; by examining leaves three or four weeks after spraying, to determine the number and distribution of insects that survived ; and by making unit counts in June following the spraying in August of the preceding year, to determine the number of insects present in rows of trees treated by different operators. Ratings on the work of 44 operators are given in detail in 5 tables, and marked differences in proficiency of spray application are shown.

Ebeling (W.). **Toxicants and Solids added to Spray Oil in Control of California Red Scale.**—*J. econ. Ent.* **33** no. 1 pp. 92–102, 10 figs., 15 refs. Menasha, Wis., 1940.

The following is the author's summary of experiments in California : Within recent years, attempts to increase the effectiveness of oil spray against the California red scale (*Aonidiella aurantii*, Mask.) by the addition of derris resins (25 per cent. rotenone) in suitable mutual solvents [*cf. R.A.E.*, A **26** 574] have shown sufficient promise to warrant further investigation.

In orchard experiments, counts were made of the natural mortality prior to treatment, and the percentage of survival of adult female scales was recorded after treatment. Counts were made of dead and live scales on 20 fruits and 20 units of branches on each of 10 lemon trees in each plot. A branch unit consisted of 2 inches of an infested branch as seen from one aspect. Only adult female scales were examined. The effectiveness of oil spray decreases as the population density increases, therefore " survival curves " were prepared to show the relation of percentage of survival to population density. A comparison of the survival curves shows the relative effectiveness of the treatments. In order to correlate the deposit of oil with the effectiveness of the various sprays, a method was developed by which the upper surfaces of each of 50 leaves were sprayed. After the water had evaporated from the leaves, the oil was washed off with petroleum ether. The oil and solvent were then filtered, the ether was evaporated by heat, and the oil was weighed.

The oil-toxicant sprays, in which 10 per cent. derris resins in dibutyl phthalate were added to oil in the proportion of 1 part of toxic solution to 15 parts of oil, deposited much less oil than the sprays containing the same amount of oil but no toxic solution. However, despite the lower oil deposit, the oil-toxicant sprays resulted in a greater mortality of red scale. The addition of walnut-shell flour to emulsive oil resulted in an increase in the effectiveness of the oil against the red scales without increasing oil deposit. When the walnut-shell flour was added to the oil-toxicant solutions, their effectiveness was also increased. Thus the addition of 1 part of a 5 per cent. solution of derris resins in dibutyl phthalate to 7 parts of medium oil at 2 per cent. concentration resulted in a survival of 3·9 per cent. of adult female insects on the branches of lemon trees, as compared to a survival of 21·2 per cent. when the oil was used alone at 2 per cent. concentration. When 3 pounds of walnut-shell flour were added to 2 U.S. gallons of the oil-toxicant, however, only 0·98 per cent. of the insects survived the treatment. Similar increases in the effectiveness of the oil by the addition of toxicant and walnut-shell flour were shown by counts made on the fruits.

Upholt (W. M.) & Hoskins (W. M.). **Factors concerned in the Deposit of Sprays. VII. Design and Use of a photographic Apparatus for studying the Impact and Movement of individual Drops upon a Surface.**—*J. econ. Ent.* **33** no. 1 pp. 102–107, 5 figs., 3 refs. Menasha, Wis., 1940.

The following is the authors' summary of this seventh paper of a series [*cf. R.A.E.*, A **27** 411 ; **28** 185] : An apparatus is described and figured for taking pictures, with very short exposure, of drops of a

liquid at any desired time before, during or after contact with a solid surface. From the pictures, accurate measurements can be made of the advancing and receding angles. The effects of continued spraying may be studied by allowing any desired number of drops to strike and move down the surface. Since the method is relatively cheap, it enables many tests to be made so that small differences in behaviour may be evaluated with precision.

SWAIN (A. F.) & BUCKNER (R. P.). **Toxicity of Hydrocyanic Acid to Eggs of Black Scale** (*Saissetia oleae* (**Bern.**)).—*J. econ. Ent.* **33** no. 1 pp. 107–111, 1 fig., 5 refs. Menasha, Wis., 1940.

Since most recommendations for fumigation with hydrocyanic acid gas against *Saissetia oleae,* Bern., on *Citrus* in southern California are based on the assumption that the eggs are highly resistant to HCN, the season for fumigation is very short ; in some years only 3–4 weeks are available in the coastal districts and only about 2 months in the interior. Experiments were therefore carried out between 19th November 1935 and 10th January 1936 and between 28th May and 9th July 1936 to determine the toxicity of HCN to the eggs of this Coccid. All the eggs were exposed for 45 minutes to gradually decreasing concentrations of HCN as they would be in a fumigation tent. In each series of experiments, four tests were made, with mean average concentrations of approximately 0·07, 0·08, 0·09 and 0·1 per cent. HCN in air by weight. These concentrations are equivalent to those obtained in commercial fumigation of *Citrus* by the 14, 16, 18 and 20 cc. schedules. The results of the first series against eggs from districts in which there are normally 2 generations in the year showed that the fumigant was highly toxic to the winter eggs and that its toxicity increased directly with its concentration and the development of the embryo. Analysis of variance failed to show any effect of date of treatment, but the individual tests indicated that though some eggs hatched after exposure to all four concentrations early in November, the 0·1 per cent. concentration killed all eggs on and after 29th November, the 0·09 per cent. did so on and after 22nd December, and the 0·08 per cent. did so on 10th January. The 0·1 per cent. concentration is equivalent to the minimum normal dosage for winter fumigation.

The second series of experiments, in which the tests were made once a week against single- and double-brooded scales and against resistant, semi-resistant and normal forms [*cf. R.A.E.*, A **18** 41], confirmed the results of the first. The summer eggs proved much more susceptible than the winter ones, and none of those exposed to the two higher concentrations after 4th June hatched. This was 6–7 weeks earlier than the beginning of commercial fumigation in any of the localities from which the eggs were obtained. No eggs hatched after exposure to any concentration on or after 26th June. The analysis of variance showed clearly the significance of both concentration and date of treatment. There was no difference in susceptibility of eggs from the different sources, and this suggests that satisfactory control of resistant forms might be obtained by fumigating earlier in the season than usual.

In a small-scale field experiment on lemon trees, no eggs of a resistant strain of *S. oleae* hatched when fumigation was carried out on 2nd June at the 18 cc. schedule or on 7th July at the 14 cc. schedule, and only

3·2 per cent. did so following fumigation at the lower rate on 11th June. It was estimated that the percentages of eggs that had already hatched on 2nd June and 7th July were about 50 and 80, respectively.

Morrison (H. E.). **Small Plots in Field Experiments on Hop Pests.**—*J. econ. Ent.* **33** no. 1 pp. 112–113, 1 fig. Menasha, Wis., 1940.

A description is given of a method developed in 1938 for experiments against pests of hops at Corvallis, Oregon. A half-acre block of 1- and 2-year-old plants was divided into 7 equal plots, which were subdivided into 8 equal parts, each containing 6 plants. Treatments were arranged by strict random distribution, and occurred once in each plot. Records of the density and distribution of *Tetranychus telarius*, L., on each plant were taken every 10 days [*cf. R.A.E.*, A **28** 614]. Statistical analysis of the data obtained before spraying was begun showed no significant difference between means for the 7 different series of 8 subdivisions. The experimental method is therefore considered satisfactory. The small size of the plots enabled them to be sprayed in a short time in the early morning, so that the strong air currents prevalent during the day were avoided.

Upholt (W. M.) & Craig (R.). **A Note on the Frequency Distribution of Black Scale Insects.**—*J. econ. Ent.* **33** no. 1 pp. 113–114, 1 ref. Menasha, Wis., 1940.

A table is given showing the differences between the observed frequency distribution of different numbers of the black scale [*Saissetia oleae*, Bern.] on 821 unit samples from orange trees in California and those calculated on the basis of two theoretical types of distribution. It illustrates the fact that the actual distributions of insect populations and the way in which they are affected by environmental factors must be studied before statistical methods applicable to them can be developed.

Barnes (D. F.) & Kaloostian (G. H.). **Flight Habits and Seasonal Abundance of Dried-fruit Insects.**—*J. econ. Ent.* **33** no. 1 pp. 115–119, 1 fig. Menasha, Wis., 1940.

The following are substantially the authors' summary and conclusions: A motor-driven rotary net, operated in a raisin storage yard at Fresno, California, from 14th April to 31st October 1938, gave data on the comparative abundance from day to day of 16 species or groups of insects [*cf. R.A.E.*, A **28** 481]. The raisin moth, *Ephestia figulilella*, Gregson, and the Indian meal moth, *Plodia interpunctella*, Hb., comprised 94 per cent. of the moths recorded. Among the beetles, Nitidulids and Dermestids were the most plentiful. The most abundant insect in stored raisins, the saw-toothed grain beetle, *Oryzaephilus surinamensis*, L., was taken from the air in very small numbers.

The flight habits of 12 species or groups were studied in detail by means of collections made at intervals of 15 minutes on 10 days. The dried fruit beetle, *Carpophilus hemipterus*, L., and the Dermestids were shown to fly during daylight, while the other beetles recorded were predominantly crepuscular. All the species of storage moths captured flew during the night, flight usually beginning about sunset. On warm nights, *E. figulilella* and *Ephestiodes nigrella*, Hulst, were on the wing until sunrise.

WEHRLE (L. P.). **The Discovery of an Alfalfa Weevil (*Hypera brunneipennis* Boheman) in Arizona.**—*J. econ. Ent.* **33** no. 1 pp. 119–121, 1 ref. Menasha, Wis., 1940.

An account is given of the discovery of *Hypera brunneipennis*, Boh., in the Yuma district of Arizona in 1939 on fenugreek (*Trigonella foenum-graecum*), sour clover (*Melilotus indica*), bur clover (*Medicago hispida*) and lucerne [*cf. R.A.E.*, A **28** 120, 187]. Weevils that emerged in the laboratory and were put on tips of lucerne in petri dishes at ordinary room temperatures on 27th April drank copiously from moist cotton wool placed on the following day over the cut ends of the tips and fed voraciously, first on the flowers and unopened flower buds and leaves, which they shredded, and then on the stems, in which they made elongated scores. The last emergence occurred on 1st May, and after 6th May both old and younger weevils were less active; they stopped feeding entirely and rested among the tips or round the moist cotton. The weevils did not attempt to fly, but tried to hide among the leaves or feigned death when disturbed.

FERGUSON (G. R.). **Life History of the Western Strawberry Leaf Roller with Notes on its Control.**—*J. econ. Ent.* **33** no. 1 pp. 121–123, 3 refs. Menasha, Wis., 1940.

The western strawberry leaf-roller, *Anacampsis fragariella*, Busck, all stages of which are briefly described, has been a minor pest of strawberries in western Oregon for a number of years. It occasionally causes severe damage, but has never been a serious problem for many years in succession, apparently because of the action of parasites and the practice of removing strawberry plantings after 4–5 years. Heavily infested plants are ragged in appearance, and the injury to the leaves may seriously reduce plant vitality.

Preliminary observations on the life-history of the Tineid in 1937 and 1938 showed that it has one generation a year in western Oregon, and overwinters in the egg stage on the old strawberry leaves. The larvae hatch in late April and early May and feed on the new growth, typically between the folds of the developing leaflets; later they roll the leaflets and web them together. They pupate during late June and early July, and the adults emerge during the middle and latter part of July. The pre-oviposition period lasts 2–3 weeks, and the females oviposit on the leaves, along the mid-rib and larger leaf veins, over a period lasting as long as a month. The average oviposition period was 18·7 and 20 days and the average number of eggs per female 100·1 and 43·3 in 1937 and 1938. Adults survived for over 2 months, the average longevity in 1937 and 1938 being 41·5 and 60·1 days for the females and 48·7 and 53 days for the males. Parasites bred from *A. fragariella* in Oregon were *Microgaster phthorimaeae*, Mues., and *Microbracon gelechiae*, Ashm.

Observations were made in 1937 and 1938 on the effect on infestation by this Tineid of cultural practices used for the control of the strawberry crown moth [*Aegeria bibionipennis*, Boisd.] in recent years [*cf. R.A.E.*, A **26** 291]. The plants were topped with an ordinary mower, covered by a cultivator that had the shovels adjusted to throw the earth over the plants, or subjected to both treatments immediately after harvest in 1936 and 1937, when the adults of *A. fragariella* were flying. Neither topping nor covering alone gave satisfactory control,

probably because some leaves remain exposed after either treatment, but a combination of both, which left very few leaves exposed, resulted in an average reduction of 92·5 per cent. in the number of injured leaves. Topping appeared to have no injurious effect on the growth and yield of the plant, but the combined treatment would probably be advisable only under conditions of heavy infestation.

Bailey (S. F.). **The Distribution of injurious Thrips in the United States.**—*J. econ. Ent.* **33** no. 1 pp. 133–136, 1 fig., 1 ref. Menasha, Wis., 1940.

A list is given of the Thysanoptera recorded as of economic importance in the United States; they comprise the genus *Frankliniella* and 31 species of other genera, and are grouped as those of major importance, those of minor importance and those rarely injurious or reported as such very infrequently. The distribution in the United States of those in the first two categories is shown on a map and that of all of them in a table.

The distribution and importance of various species are briefly discussed. The apparent absence of thrips in such States as Arkansas, Oklahoma, New Mexico, Vermont and North Dakota is undoubtedly due to lack of data, but their paucity in the central States appears to be correlated with the extensive grassland area east of the Rocky Mountains, where the flora is less rich than in the eastern and far western States, and with cultural practices and the absence of diversified agriculture. Some species with a wide range of food-plants and a wide distribution, such as *Thrips tabaci*, Lind., are not narrowly restricted by rainfall, temperature or cultural practices, though these factors may regulate their seasonal fluctuations, whereas others, like the pear thrips, *Taeniothrips inconsequens*, Uzel, are limited in distribution, often confined to very local areas and depend on certain moisture and temperature conditions of the soil. The distribution of 9 species of *Frankliniella* shows that, even within a genus, some species are much more narrowly limited than others.

Eichmann (R. D.). **The Pea Aphid on Canning Peas in eastern Washington as influenced by Alfalfa Plantings.**—*J. econ. Ent.* **33** no. 1 pp. 137–139, 5 figs. Menasha, Wis., 1940.

Severe damage was caused to canning peas in the foothills of the Blue Mountains of eastern Washington in 1934 by the pea aphis [*Macrosiphum onobrychis*, Boy.]. Lucerne, its principal winter food-plant in this district, was not grown to any extent in the foothills at that time, and the Aphids apparently developed on that grown for hay in the valleys to the west of them. The growing of lucerne to control soil erosion subsequently came into general use in the foothills, and it seemed possible that this might tend to increase the damage to the pea crop. Data on the movements of the Aphid population were therefore obtained by sweeping representative lucerne plantings and pea fields with a net at frequent intervals throughout each of 3 growing seasons. The results showed that the Aphids breed on a food-plant while it remains succulent, after which winged forms appear and migrate to fresh plants. The Aphids occur in small numbers on hay-meadow lucerne at altitudes of about 1,000 ft. early in spring, and begin to multiply in April, the population reaching a peak during May. Later, when this lucerne begins to mature, winged forms

migrate to lucerne planted for erosion control, on which the Aphids feed and reproduce until it matures, about a month later, or to young early peas, on which winged forms are numerous for about 2 weeks, and the total population reaches a peak at about the end of May. The population density is comparable on the two plantings and is never so high as on the hay-meadow lucerne. Migration to the main crop of peas takes place at about the same time from both crops, and the population density becomes still lower. As each field matures and is vined, the Aphids migrate to younger plantings. Towards the end of the canning season, the acreage becomes greatly reduced, and the population is concentrated in the remaining fields, in which it increases rapidly, possibly because the late fields are at the highest elevations and are often adjacent to woodland, so that atmospheric conditions are probably favourable for the development of Aphids in late summer. The heavy infestation of 1934 occurred in late fields of this type, and the comparative freedom from infestation in recent years is probably due to the elimination of late peas by planting before 15th May, and to the prevalence of normal drought conditions at harvest. Throughout the summer, winged Aphids migrate back in small numbers to lucerne, on which they are barely able to maintain themselves, and in August a minimum population is present. Lucerne on the hillsides is too dry at this time to support Aphids [*cf. R.A.E.*, A **26** 489], and it is therefore concluded that it does not serve as a winter food-plant. Even at the time of spring migration, it is of less importance as a food-plant than are the early peas, which are usually grown in large fields at lower elevations near the hay meadows.

MICHELBACHER (A. E.). **Some entomological Observations in California.** —*J. econ. Ent.* **33** no. 1 pp. 141–143. Menasha, Wis., 1940.

The author considers that the determination of complete life-histories of insect pests under natural conditions and accurate observations of population trends over a period of years are probably the most important contributions that can be made to economic entomology, since an understanding of the relation of an insect to its environment will probably simplify the problem of control. Instances are given of the influence of size of plantings and preferred food-plants on the extent of the damage done by insects to some important agricultural crops in California. Near San José, *Diabrotica soror*, Lec., caused serious damage to pole beans for several successive years. The individual plantings were usually small, and the beetles became concentrated on them. In 1938, however, there were established large plantings of lima beans, which were harvested green. These appeared to be as attractive to *D. soror* as the pole beans, with the result that the population was greatly diluted, and no serious damage was caused to either crop.

Heliothis armigera, Hb. (*obsoleta*, F.) apparently prefers maize and beans to tomato, and in northern California the most serious damage is caused to tomato after the maize and beans have matured. It is suggested that if the preferred food-plants were not grown and there were no moths migrating from a great distance, infestation of tomato would be less over the entire season than where maize and beans are grown in abundance. Hornworms [*Protoparce*] that seriously attacked a small autumn crop of potatoes in one area had evidently migrated to them from *Datura*, on which the population had been built up. It

is considered that attacks will be less serious when the acreage of potatoes in this area increases, as the number of moths produced on the wild food-plant will be insufficient to infest the larger plantings. It is unlikely that populations can be built up on potato, judging by the lateness of its infestation. It is emphasised that control by such means as crop management and cultural practices is preferable to the use of chemicals.

GNADINGER (C. B.), MOORE (J. B.) & COULTER (R. W.). **Experiments with Pyrethrum for the Control of Codling Moth** (*Carpocapsa pomonella* **L.**).—*J. econ. Ent.* **33** no. 1 pp. 143–153, 7 figs., 14 refs. Menasha, Wis., 1940.

It has not hitherto been possible to obtain satisfactory control of *Cydia* (*Carpocapsa*) *pomonella*, L., by means of pyrethrum, but since the development of new types of pyrethrum insecticides has made possible the control of insects against which pyrethrum was not formerly used, comprehensive tests were begun under commercial conditions in a heavily infested locality in Washington State on their use in sprays against the overwintering larvae and in dusts in summer.

Several pyrethrum sprays gave insufficient mortality when tested against overwintering larvae removed from their cocoons, and an aqueous spray failed to reach and penetrate many cocoons on the tree, but a spray of kerosene containing 60 mg. pyrethrins per 100 cc. applied in July gave 99 and 97 per cent. mortality of larvae and pupae under the bark, respectively. It apparently penetrated into all the larval refuges and easily wetted the cocoons. Investigations carried out on three varieties of apple in heavily infested orchards showed that the larvae preferred to hibernate under the bark of the tree ; few were found on small branches with smooth bark, except in crotches, cracks or pruning scars, and scraping the upper two-thirds of the tree caused them to concentrate in the bark of the lower third. Scraping the entire tree tended to drive the larvae into the cover crop and débris near the base of the tree. The proportion of larvae hibernating in the soil was negligible, and none there was observed to be in a cocoon.

Since a sufficiently thorough application of the pyrethrum-kerosene spray to the entire tree would result in severe damage to foliage and fruit buds, even in the dormant stage, and application as a fine mist would not penetrate the hibernating places of the cocoons, the treatment suggested is as follows. When all the apples are harvested, all fallen apples, props and other material that might shelter larvae should be removed, and the upper two-thirds of the tree should be scraped to remove hibernation sites and hibernating larvae, the scrapings being caught in a tarpaulin and burnt. From 4 to 8 ft. of the trunk and leaders should be left unscraped, according to the age of the tree. About 3 days later, when any larvae migrating to the tree will have reached it, the rough bark on the trunk and leaders should be sprayed at a pressure of 20–30 lb. until it is thoroughly wet. A small portable sprayer with a hand-operated pump is sufficient. Any loose bark and rubbish on the ground within 2 ft. of the tree should also be sprayed. The spraying should be repeated each year. Scraping is unnecessary in the second year, but after pruning, the spray solution should be applied by means of a pressure oil can to scars, cracks and crotches in the upper part of the tree.

A block of 93 trees had the upper two-thirds scraped in June, and the pruning scars and crotches treated and the trunk and leaders sprayed in October. On one typical tree, 64·7 per cent. of the larvae on the upper two-thirds and all those in the lower third and in bark 0–3 ins. below the ground were killed. The spray caused no visible injury to trees treated in autumn, or to apple trees of 8 varieties when it was applied to their trunks and leaders in July, when the temperature was 112°F. and humidity low ; in the latter case it had no permanent repellent effect on the larvae, and many overwintering individuals were found under the bark of the trees after harvest. The average cost per tree per year for 30-year-old trees of 5 varieties was 68 cents. The spray is also of value for use on prop piles, boxes, packing sheds and other sites favourable for hibernation.

In experiments in the laboratory, a dust containing 0·2 per cent. pyrethrins gave complete mortality in 18 and 24 hours when applied to adults and mature larvae, respectively, and in 2 hours when applied to foliage on which newly hatched larvae were subsequently placed. Under similar conditions, a dust containing 1 per cent. dinitro-o-cyclohexylphenol in walnut-shell flour and a cubé dust (0·96 per cent. rotenone) killed only 30 and 19 per cent. of the adults and 23 and 71 per cent. of the mature larvae.

In large-scale tests in a severely infested orchard containing apples of a susceptible variety, a dust of 10 per cent. Dry Pyrocide (a concentrate composed of an oil solution of pyrethrins mixed with diatomaceous earth, standardised to contain 2 per cent. pyrethrins and stabilised with an antioxidant) and 90 per cent. talc, applied at the rate of about 2 lb. per tree by means of a specially constructed dusting apparatus proved effective against the adults. They began to fall 3–4 minutes after the dust was applied, and the last fell about an hour later ; 96 per cent. of those knocked down were dead after 18 hours, and 49·8 per cent. of those killed were females. The maximum number of moths knocked down from a single tree by one application was 41. Of mature larvae that had left the fruits and were knocked down by the dust, 69·5 per cent. died as larvae and 8·5 per cent. as pupae. The largest number of larvae per tree knocked down by one application was 19. Newly hatched larvae were readily killed by the dust, which appeared to remain toxic to them for about 24 hours after application, even at high temperatures and in a fairly bright light. The effectiveness of the treatment was augmented by the use of sprays containing 0·5–0·75 per cent. medium oil (92 per cent. unsulphonatable residue), which had considerable ovicidal action and helped to control mites. In all, the plot received a calyx spray and one cover spray of lead arsenate, 20 applications of dust and 5 oil sprays ; a neighbouring plot of the same variety received a calyx spray and 11 cover sprays of lead arsenate (applied at the rate of 65 gals. per tree, and, in 10 of the cover sprays, containing 3 lb. lead arsenate per 100 U.S. gals.). Considerably fewer moths were caught in bait-traps in the dusted plot than in that sprayed with lead arsenate. There was little difference between the plots in the proportion of dropped apples, thinnings and fruit containing larvae, but the dusted apples had only one-fifth as many " stings" as the others, matured earlier and had a better colour. They were below tolerance for lead and arsenic after being wiped, whereas those that had received the full schedule of lead arsenate required an alkaline wash followed by an acid wash. The cover crop was better in the dusted plot.

It was found after the experiment had begun that dusting was more effective in the early morning, when the moths are inactive and the air still. It is considered that this practice might reduce the number of dustings required, and furthermore that the cover spray of lead arsenate was unnecessary. Other insects knocked down by the dust were buffalo treehoppers [*Ceresa bubalus*, F.], rosy aphis [*Anuraphis roseus*, Baker], leaf-roller larvae and species of *Lygus*. The European red mite [*Paratetranychus pilosus*, C. & F.], the Pacific mite [*Tetranychus pacificus*, McG.] and Coccids were not appreciably affected by the dust. It is compatible with copper compounds, sulphur and nicotine.

Pyenson (L.). **A new Machine for Turf Dusting and Hairy Chinch Bug Control.**—*J. econ. Ent.* **33** no. 1 pp. 153–155, 1 fig., 2 refs. Menasha, Wis., 1940.

The following is based on the author's discussion and conclusions: A machine is described that uses new principles in the application of dusts to turf. It drives dusts evenly into the turf and draws some of the waste dust back into the air-stream by means of a vacuum return. By its use economic control of a heavy infestation of *Blissus hirtus*, Montd., in dense turf on Long Island was obtained with two applications of a dust of derris and talc containing 1 per cent. rotenone at the rate of 10 lb. per 1,000 sq. ft., less than half the amount of rotenone dust formerly recommended [*R.A.E.*, A **25** 688]. No injury to the turf was observed. Light even applications to turf of lead-arsenate dust for the control of Lamellicorn larvae and sod webworms [*Crambus*] are also made practicable through the use of this machine.

Hensill (G. S.). **Determination of Mineral Oil Deposits on Plant Surfaces in Field and Laboratory.**—*J. econ. Ent.* **33** no. 1 pp. 155–159, 1 ref. Menasha, Wis., 1940.

During 1938 and 1939, a laboratory method for determining the amount of mineral oil deposited on orange leaves immediately after spraying [*R.A.E.*, A **25** 552] was adapted to the determination of mineral-oil deposits on the foliage of lemon and Valencia and Navel oranges sprayed with various oil emulsions and sampled in the field. The resulting changes in technique and other factors concerned with the field and laboratory work are described and discussed. For each tank of spray, 25 leaves were cut from each of 4 trees freshly sprayed with material from the middle portion of the tank, and allowed to drain for about 10 minutes before being washed with acetone. The methods of washing the leaves and distilling the acetone, of treating the residue with petroleum ether, sulphonating and centrifuging [*cf. loc. cit.*] are described in detail. The same technique was used in laboratory tests on leaves and in a small number of laboratory and field tests on the bark of young growth of plum and apple. Twig sections averaging about $\frac{1}{2}$ in. in diameter and 4–5 ins. in length were used. The method gave concordant results in duplicate tests in the field and in the laboratory.

Pearce (G. W.) & Avens (A. W.). **Preparation of commercial Calcium Arsenate for Use as an Orchard Insecticide.**—*J. econ. Ent.* **33** no. 1 pp. 159–162, 6 refs. Menasha, Wis., 1940.

The value of calcium arsenate as an orchard insecticide is determined by its toxicity to insects and the degree of injury it causes to the foliage. It has been shown [*R.A.E.*, A **24** 256] that a calcium

arsenate having a water-soluble arsenic content of not more than 0·75 per cent. As_2O_5, as determined by the experimental method evolved, is relatively safe to most foliage. The production of such a calcium arsenate necessitates careful control of temperature, concentration of reagents and rate of stirring [**25** 435], and no index for estimating the comparative toxicity to insects of " safe " and " unsafe " calcium arsenates has been made available to manufacturers. An account is therefore given of a method developed at the New York State Agricultural Experiment Station to prepare experimental batches of calcium arsenate of the safe type, and of field tests in 1936 to compare the material obtained with " safe " calcium arsenate and with lead arsenate. All sprays contained 3 lb. of the arsenical per 100 U.S. gals. water, with a spreader, and 5 applications were made at about fortnightly intervals for the control of the codling moth [*Cydia pomonella*, L.] on apple. The results showed that the experimental calcium arsenate (0·45–0·55 per cent. water-soluble As_2O_5) with or without the addition of hydrated lime (3 and 9 lb. per 100 U.S. gals.) gave over 95 per cent. control and was as effective as lead arsenate and 2 lb. lime per 100 U.S. gals. It was more effective than the commercial calcium arsenate (0·25 per cent. water-soluble As_2O_5), which gave only 53·5–73·1 per cent. control in similar sprays, but it also caused more injury to the foliage. The addition of 9 lb. lime to the experimental calcium arsenate and of 3 or 9 lb. to the commercial one rendered them no more injurious than the lead arsenate, but lime does not always render calcium arsenate so safe as these results would suggest. On the other hand, spray injury of various types was prevalent in New York orchards in 1936, and the calcium arsenates were more injurious than similar ones had been in previous seasons.

VAN LEEUWEN (E. R.). **The Activity of Adult Codling Moths as indicated by Captures of marked Moths.**—*J. econ. Ent.* **33** no. 1 pp. 162–166, 1 ref. Menasha, Wis., 1940.

The following is substantially the author's summary : Studies on the use of baits for the control of adults of the codling moth [*Cydia pomonella*, L.] during 1932–38 at Yakima, Washington, included the release and recovery of marked moths. In addition to records on the proportion of the marked moths recovered, much information was obtained on their flight habits. The percentages of marked moths recovered ranged from 6 to 96. The highest recoveries were made with baits composed of fermenting molasses with pine-tar oil in an isolated orchard in which nearly every tree was baited. Most of the moths recovered in an 8-acre baited area of an apple orchard were taken within 150 ft. of the point of release. The average distance travelled was 143 ft. About 75 per cent. of the moths recovered were taken within 6 days. The spread of moths from the point of liberation appears to have been greatest in a northerly direction, or against the prevailing winds. Of the moths liberated at various distances outside the baited areas, very few were recovered, an indication that the bait used did not attract many of the moths for long distances.

GOODHUE (L. D.). **Particle Size of commercial Lead Arsenate by Sedimentation Analysis.**—*J. econ. Ent.* **33** no. 1 pp. 170–172, 6 refs. Menasha, Wis., 1940.

The particle-size distribution in 9 brands of commercial lead arsenate was determined by an improved method of sedimentation

analysis [*R.A.E.*, A **27** 541]. The results showed that commercial lead arsenates are very finely divided powders. The particle size varied considerably, but was usually below a diameter of 2 microns. The coarsest lead arsenate sample was at least as fine as the finest calcium arsenate [*cf.* **25** 692] and much finer than the finest Paris green [*cf.* **26** 282] studied by this method. The samples contained 10·5–60·3 per cent. of material with a diameter of less than 1 micron. This minute fraction was almost colloidal in nature and remained in suspension for a week or more. No samples specially treated to reduce the particle size were examined. The loose bulking value of the various lead arsenates was not well correlated with the particle size, as judged by the large proportion below 2 microns in diameter, though the finest sample had the highest bulking value.

LATTA (R.). **Methyl Bromide Fumigation for Destruction of Pod Borer Larvae.**—*J. econ. Ent.* **33** no. 1 pp. 176–179. Menasha, Wis., 1940.

The importation of vegetable products that may be infested with the larvae of *Maruca testulalis*, Geyer, into the United States, where this Pyralid is not known to occur, is allowed only during the winter and after official inspection at the port of entry, or, if shipped from Porto Rico, at San Juan. At the beginning of the winter of 1938–39, any shipment found infested was refused entry, thus causing considerable loss to importers. Experiments were therefore carried out from November 1938 to April 1939 at New York City and San Juan to determine the effect of fumigation with methyl bromide at atmospheric pressure or at reduced pressure maintained for the period of exposure on the larvae of *M. testulalis* in string beans and green lima beans.

The following is based on the author's summary: Fumigation at dosages as low as 0·5 lb. per 1,000 cu. ft. gave complete mortality of the larvae at normal temperatures (above 70°F.) either in a vacuum of 15 ins. mercury for 90 minutes or under atmospheric pressure for 2 hours. At low temperatures, high dosages of the fumigant were required. Green lima beans, pigeon peas [*Cajanus cajan*] and string beans were uninjured at dosages considerably higher than those needed to kill the larvae. Tests on the first two products were also made under commercial conditions. For fumigation of commercial shipments, it is recommended that 1·5 lb. methyl bromide per 1,000 cu. ft. should be used at temperatures above 70°F., either in a 15-inch vacuum for 90 minutes or at atmospheric pressure for 2 hours, and 3 lb. per 1,000 cu. ft. for 90 minutes in the same vacuum for temperatures below 70°F.

HAEUSSLER (G. J.). **General Information concerning the Oriental Fruit Moth in Japan and Chosen.**—*J. econ. Ent.* **33** no. 1 pp. 189–193, 1 fig., 4 refs. Menasha, Wis., 1940.

Notes based on the literature and the experience of local workers are given on the life-history, economic importance and control of *Cydia* (*Grapholitha*) *molesta*, Busck, in Japan and Korea, and observations incidental to a survey of its parasites in these regions made by the author in 1932 and 1933 are included. Its habits and importance in Japan and the United States are compared. It is now generally distributed throughout central and southern Japan and occurs in all the prefectures of Korea, but no records were found of its presence

on Hokkaido [but *cf. R.A.E.*, A **20** 246]. A list of food-plants is given from two papers already noticed [**12** 92; **16** 483]. The injury it does is said to be often confused with that caused by *Carposina sasakii*, Mats., a common pest of peach, pear, apple, quince and plum in Japan and Korea.

The principal and most effective method of control in Japan and Korea consists in covering the fruits with paper bags of various types, some of which are described. In one large quince-growing area, hibernating larvae are destroyed by scraping the bark from the trees during winter. This practice considerably reduces the large over-wintering population. In some orchards, the infested peach twigs are clipped off and burnt, but this is probably of little value, owing to the migration of moths from neglected peach orchards or from pear orchards in the neighbourhood.

CHANDLER (S. C.). **Mounding Peach Trees following Applications of Ethylene Dichloride Emulsion and of Paradichlorobenzene Crystals.**—*J. econ. Ent.* **33** no. 1 p. 199. Menasha, Wis., 1940.

Tests were carried out in Illinois during the spring and autumn of 1939 to determine whether trees treated with ethylene dichloride emulsion for the control of the peach borer [*Aegeria exitiosa*, Say] need to be mounded and whether the mounds, if applied, need to be so large as those round trees treated with paradichlorobenzene crystals [*cf. R.A.E.*, A **27** 256, 526, etc.]. In spring about 20 per cent. and in autumn about 50 per cent. fewer borers were killed when peach trees 10–12 years old treated with ½ U.S. pint 20 per cent. ethylene dichloride emulsion were not mounded. In autumn, both ethylene dichloride emulsion and paradichlorobenzene (1 oz. per tree) gave effective control (93·4 and 96·4 per cent. mortality) with small mounds (about 3 ins. high). Paradichlorobenzene gave about 81 per cent. mortality with a 1-inch mound, but less than 3 per cent. without a mound.

HANSBERRY (R.). **A new Pest of Hollyhock** (*Anthomyza angelicae* **Frost**).—*J. econ. Ent.* **33** no. 1 p. 199, 1 ref. Menasha, Wis., 1940. **Correction.**—*T.c.* no. 4 p. 711.

On 18th September 1938, hollyhock flower-stalks in New York State were found to have been mined extensively by larvae that had pupated in the lower 6 ins. of their length. As many as 35 pupae were found in one stalk and only 2 of about 100 insects were still in the larval stage. Adults that emerged from pupae kept in the laboratory between 10th January and 1st March 1939 were identified as *Agromyza angelicae*, Frost. This Agromyzid was described from New York as infesting *Angelica atropurpurea* and has also been recorded in California.

Adults were observed on the hollyhock plants during early June 1939, and egg punctures were first found among the lower flower-buds on 8th June. Oviposition continued for several days, and larval tunnels were begun about 25th June. The total distance travelled by the larvae was sometimes more than 6 ft., though the flower-stalks are only about 3 ft. high when the eggs are laid. The plants grow and flower almost normally except for early drying up of the flower-stalks in late summer. Parasites that emerged from the pupae during January and February 1939 were identified as the Pteromalid, *Syntomopus americanus*, Ashm.

MARSHALL (G. E.). **Some newly discovered Habits of the Codling Moth.** —*J. econ. Ent.* **33** no. 1 p. 200. Menasha, Wis., 1940.

In experiments in Indiana in 1939, a Benoni apple tree that had received scab and calyx sprays and had a heavy set of fruit was isolated by means of a muslin tent, after the ground beneath it had been made bare and smooth, and 35 adults of the codling moth [*Cydia pomonella*, L.], the sex of which was not determined, were released in the tent on 18th May. The dropped apples were collected, counted and examined for larvae at intervals until 29th July, when all the apples remaining on the tree were picked and examined. The high biotic potential of *C. pomonella* under favourable conditions is indicated by the fact that the estimated number of moths that had been produced up to the middle of the active season was more than 557 times as great as the number placed on the tree at the beginning of the season.

When the first-generation larvae were ready to pupate, adhesive bands were placed round the trunk at the surface of the ground and at 18-inch intervals on the trunk and all branches 3 ins. or more in diameter. Not being able to cross the bands, a number of larvae pupated on the bare surface of the ground, some without making a cocoon, in spite of which they gave rise to adults. Others pupated in the areas on the tree between the bands, having presumably swung against the trunk on silken threads. Comparatively few were trapped on the bands. Pupation took place all over the tree, not always under such cover as bark. At least 500 larvae that hatched after the fruit was removed entered fruit spurs, sap shoots at leaf bases, new breaks in twigs and small branches, and enlargements caused by the feeding of the woolly aphis [*Eriosoma lanigerum*, Hsm.]. Those that entered twigs started feeding just below the bark and later consumed considerable amounts of wood at the centre of the twigs. Full-fed larvae were seeking places in which to spin cocoons by 25th September.

FLANDERS (S. E.). **A Brazilian Parasite of** *Pseudococcus maritimus* **(Ehrh.).**—*J. econ. Ent.* **33** no. 1 p. 201, 3 refs. Menasha, Wis., 1940.

Mealybugs from a light infestation on ivy (*Hedera helix*) at São Paulo, Brazil, were sent to Riverside, California, in December 1934, and from them 3 females of *Aenasius paulistus*, Comp., emerged on 23rd December [*cf. R.A.E.*, A **26** 212]. Examination of one of the hosts from which they had emerged showed that it had the diagnostic characters of *Pseudococcus maritimus*, Ehrh., and the Encyrtids were therefore provided with examples of *P. maritimus* taken on grapefruit. Oviposition occurred on 25th December, and 4 males of *Aenasius* were reared, the first emerging on 20th January 1935. The single female still living paired with one of the males, but did not oviposit ; gravid females kept for 3 weeks or more in a warm temperature and not allowed to oviposit apparently lose the ability to reproduce.

A small colony of *P. maritimus* observed by Compere at São Paulo showed no evidences of parasitism, and its disappearance within a few months was attributed to the action of insect predators [**28** 373]. The mealybug host of *A. paulistus* in Brazil, which was observed by Compere to have the diagnostic characters of *P. maritimus* but the habits of *P. gahani*, Green, was later described by Hambleton as *P. sociabilis* [**24** 502]. Further attempts to introduce the Encyrtid

into California are desirable, however, since it can parasitise *P. maritimus*, which is a serious pest of pears in the San Francisco Bay region.

Wolcott (G. N.) & Martorell (L. F.). **Epidemics of Fungus Disease control Insect Pests in Puerto Rico.**—*J. econ. Ent.* **33** no. 1 pp. 201–202, 2 refs. Menasha, Wis., 1940.

Larvae of *Anticarsia* (*Thermesia*) *gemmatalis*, Hb., completely defoliated an extensive planting of velvet beans [*Stizolobium*] in Porto Rico in the autumn of 1939, as the pods were maturing. More than half of a large number of the larvae sent to Rio Piedras were found on arrival to be dead and covered with a fungous growth, and many dead and mummified larvae were observed on the infested plants ; there were often 8–10 on a single bush. The weather at the time was warm and humid, with showers every day. Though the crop was not saved, all the last-instar larvae on the plants were killed. The fungus was identified as *Spicaria rileyi*, but appeared to be intermediate between this species and the closely related *S. prasina* [*cf. R.A.E.*, A **15** 622]. An instance of the control of *Icerya purchasi*, Mask., on *Citrus* by *S. javanica* in Porto Rico in 1923 [*cf.* **22** 152] is cited for comparison. In one locality, control was so perfect that the Coccid has not reappeared.

Wolcott (G. N.). **A Tachinid Parasite of the Puerto Rican Changa.**—*J. econ. Ent.* **33** no. 1 p. 202. Menasha, Wis., 1940.

The collection of *Larra americana*, Sauss., at Belem (Brazil) for shipment to Porto Rico for the control of *Scapteriscus vicinus*, Scud. [*cf. R.A.E.*, A **27** 85] was concluded in June 1939, early in the dry season. During the last week of the work, one of the hundreds of examples of *S. vicinus* that were being used for oviposition by the Sphegid was found dead with a Dipterous puparium beside it. A Tachinid fly emerged 11 days later (in Porto Rico) and was identified as *Euphasiopteryx australis*, Tns. One more cricket at Belem and several in transit to Porto Rico were also found to be parasitised by this Tachinid ; the apparent rate of parasitism was 0·5 per cent.

Flanders (S. E.). **A Coccinellid introduced into California.**—*J. econ. Ent.* **33** no. 1 pp. 202–203, 1 ref. Menasha, Wis., 1940.

Scymnus pumilio, Weise (*flavifrons*, Blkb.), all stages of which are briefly described, was stated by Koebele (1893) to be common in various parts of Australia, where it is predacious on a number of different Coccids. In 1931, it was found in a shipment of the black scale [*Saissetia oleae*, Bern.] received in California from New South Wales and was reared in the laboratory. The newly hatched larvae were active and attacked young scales and mealybugs, but they became sluggish after they had begun to feed. The life-cycle lasted 4–8 weeks at temperatures of 75–80°F. ; when development was rapid, the egg, larval and pupal stages were completed in 6, 15 and 7 days, respectively. This Coccinellid is not known to be established in California.

Wampler (E. L.). **Male Scale injurious to Olives.**—*J. econ. Ent.* **33** no. 1 p. 203. Menasha, Wis., 1940.

It is generally considered that male Coccids do little injury to plants, but during experiments on the life-history and control of *Parlatoria oleae*, Colv., on olive in California it was found that the males cause extensive damage to the fruits, rendering them unfit for pickling. The damage, which consists in discoloration of the tissue of the fruit round and below the scale, is also caused by the females, but the males may be more important as they are more numerous and have a low rate of mortality.

Livingstone (E. M.) & Swank (G. R.). **Activities of the Adult White-fringed Beetle in New Orleans and Vicinity from September 1938 to May 1939.**—*J. econ. Ent.* **33** no. 1 pp. 203–204, 1 ref. Menasha, Wis., 1940.

Observations in 1938–39 showed that adults of *Pantomorus leucoloma*, Boh., were present throughout the winter in the neighbourhood of New Orleans, Louisiana. They were collected at intervals from September to February and kept under natural weather conditions; the last died on 14th May, 3 days after the first adult from an overwintering larva was observed. There were many larvae in the soil throughout the winter, but no pupae were found until 13th April, so that the overwintering adults apparently emerged before September. Of 7 adults collected in January or February and fed on natural food-plants, such as blackberry, 3 oviposited, laying 611, 652 and 740 eggs, about 50 per cent. of which were viable, between February and May.

Knowlton (G. F.). **The European Earwig in Utah.**—*J. econ. Ent.* **33** no. 1 p. 204. Menasha, Wis., 1940.

Surveys made in Utah in 1938 and 1939 showed that large populations of the European earwig, *Forficula auricularia*, L., were present round houses and on farms in the neighbourhood of Farmington, Davis County, and Holladay and Cottonwood, Salt Lake County. Damage to fruit and flowers was reported from the infested areas during 1939. Adults of the Tachinid parasite, *Bigonicheta setipennis*, Fall. [*cf. R.A.E.*, A **25** 240], which was imported from Washington State, were released on 16th May 1939 at Farmington, where puparia were found later, and on 6th June at Holladay and Cottonwood.

Chandler (S. C.). **Control of Black Peach Aphis.**—*J. econ. Ent.* **33** no. 1 p. 204. Menasha, Wis., 1940.

Anuraphis persicae-niger, Smith, caused severe damage to the roots of peach trees planted in the autumn of 1937 on the site of an old peach orchard in Illinois, with the result that 50–75 per cent. of them died or were sickly. In the autumn of 1938, part of the orchard was reset with trees from an infested area, which were planted in holes filled with soil from outside the orchard, and in the spring of 1939, trees from an uninfested area were planted in another section, some in the usual way and others in soil from outside the orchard. In October 1939, all the trees set in fresh soil were flourishing and only lightly infested, whereas the others were dead or unhealthy and heavily infested.

Tests in the autumn of 1938 showed that ½ oz. paradichlorobenzene crystals per tree or ¼ oz. paradichlorobenzene crystals in ¼ U.S. pint oil (Dendrol) per tree killed all the Aphids on the tap root and roots near it, but that ethylene dichloride emulsion was ineffective at concentrations that were not injurious to the tree. Aphids 2 ft. away from the trunk were not reached by the insecticides. The crystals were placed in a ring 2 ins. from the trunk, and the liquids were applied to the trunks but spread out at least 2 ins. over the ground.

Sherman (F.) & Todd (J. N.). **The Mexican Bean Beetle in South Carolina.**—*Bull. S. C. agric. Exp. Sta.* no. 322, 24 pp., 10 figs., 5 refs. Clemson Coll., S.C., 1939. [Recd. 1940.]

Notes are given on the seasonal history of *Epilachna varivestis*, Muls., in South Carolina. The adults overwinter, usually from late September to May, after which time all stages occur in the field in varying abundance. Heavy emergence from hibernation follows periods of rainfall and high temperatures, and tables and graphs are given showing the course of emergence during 1931–1938, variations being observed between the cages in a ravine and those on a hill [*R.A.E.*, A **23** 658 ; **24** 806]. Investigations indicated that snap beans, cowpeas, lima beans, soy beans, velvet beans [*Stizolobium*], *Crotalaria*, lucerne and ground-nuts are the preferred food-plants, in that order. Natural enemies found in bean fields included the Coccinellid, *Ceratomegilla fuscilabris*, Muls., which destroyed the eggs, the Pentatomids, *Stiretrus anchorago*, F., and *Podisus maculiventris*, Say, which attacked the larvae, and the Pentatomid, *Euthyrhynchus floridanus*, L., and the Reduviid, *Arilus cristatus*, L., which were predacious on the adults. Adults and larvae of *E. varivestis* were occasionally observed to feed on eggs of their own species. The results of tests with various insecticides for control are shown in a table, the best being obtained with dusts and sprays of rotenone and associated compounds [*cf.* **25** 629]. The only others recommended, preferably for use in sprays, are magnesium arsenate and cryolite (synthetic or natural), but these leave a harmful residue and should not be applied after the pods form. Equipment for spraying and dusting is briefly discussed.

Herms (W. B.). **Control and Prevention of the Western Subterranean Termite.**—4 pp.

Harvey (P. A.). **The Common Dry-wood Termite.**—4 pp. Berkeley, Calif., Agric. Exp. Sta., 1939. [Recd. 1940.]

The first of these papers comprises an account, almost identical with one already noticed [*R.A.E.*, A **22** 60], of the life-history and control of *Reticulitermes hesperus*, Banks, which causes serious damage to building timber and is probably the most destructive termite in California. In the second, a similar account is given of *Calotermes minor*, Hagen, which has a much more limited distribution, but is comparable in importance with *R. hesperus* in some areas.

Callan (E. McC.). **Some economic Aspects of the Gall Midges (Diptera, Cecidomyidae) with special Reference to the West Indies.**—*Trop. Agriculture* **17** no. 4 pp. 63–66, 7 refs. Trinidad, 1940.

The introductory sections of this paper comprise a brief survey of the larval feeding habits and economic importance of Cecidomyiids

and measures for their control; cultural methods are the most important, although in some cases insecticides or resistant varieties of plants are employed.

Less than 50 species have been recorded from the West Indies, and only 16 of these are of potential or actual economic importance, 8 as predators on Coccids and 8 as pests of crops. Notes are given on the latter, based on the literature and the author's observations. *Contarinia lycopersici*, Felt, and *C. sorghicola*, Coq., are the only species of major importance. *C. lycopersici*, which infests the flowers of tomato, either causing them to wither and fall or damaging the ovary so that the fruits are deformed, occurs in St. Vincent, Trinidad, Barbados [*R.A.E.*, A **23** 713] and Grenada and probably in Hawaii [**25** 743]. *C. sorghicola* infests the developing seeds of *Sorghum*, causing them to shrivel; it is a well-known pest in the United States [**17** 86] and also occurs in Hawaii [**25** 743] and the Sudan [**24** 441]. In the West Indies, where it is thought to be of recent introduction, it has been reported from Curaçao, St. Vincent and the American Virgin Islands, and has been commonly found by the author in Trinidad infesting Guinea corn, broom corn and Sudan grass besides its wild food-plant, *Sorghum halepense*.

C. gossypii, Felt, was first observed in Antigua in 1907, where for two seasons it caused serious damage to cotton. It has also been reported from Montserrat, Tortola (British Virgin Islands), St. Croix (American Virgin Islands) and Florida [**22** 637], but is now of minor importance in the West Indies. As a result of infestation, the bracts of the young flower-buds generally flare and the buds are later shed; older ones are rendered incapable of producing bolls. *Porricondyla gossypii*, Coq., was first observed in 1903 in Barbados, where it has on occasion seriously damaged cotton, and it is also present, although not of economic importance, in Montserrat. The larvae occur in numbers beneath the bark and feed on the cambium. In cases of severe attack the stem is girdled.

Iatrophobia brasiliensis, Rübs., is found in Brazil, British Guiana, Trinidad, Tobago and St. Vincent. It causes conspicuous reddish galls on leaves of cassava [*Manihot utilissima*], but these are not as a rule sufficiently numerous to affect the plant; when they are abundant, the leaves are deformed and the growth of the plant retarded. In Trinidad, the galls are sometimes very numerous.

Asynapta citrinae, Felt, is known only from Porto Rico, where it infests the shoots of grapefruit [**21** 273] and is probably of minor importance, and *A. mangiferae*, Felt, only from Barbados. The larvae of the latter live beneath the bark of small shoots of grafted mango (*Mangifera indica*) and cause the death of the terminal part of the shoots. *Erosomyia mangiferae*, Felt, frequently destroys the inflorescences and causes galls on the newly-opened leaves of mango in St. Vincent, and has also been reported on plants received from St. Lucia. The Cecidomyiid recorded on mango in Trinidad by F. W. Urich [**9** 614] was almost certainly this species.

Two Cecidomyiids are associated with the flowers and occur in numbers on the lower surfaces of the leaves of cacao in Trinidad. These may prove to effect cross pollination, but it is thought that one occasionally oviposits in the flowers, since larvae have been observed in them, as many as 14 occurring in a single flower. Most Cecidomyiids show a marked specificity to one food-plant, and this species must therefore be regarded as a potential pest of cacao.

FENNAH (R. G.). **Observations on Behaviour of Citrus Root-stocks in St. Lucia, Dominica and Montserrat.**—*Trop. Agriculture* **17** no. 4 pp. 72–76, 3 figs., 2 refs. Trinidad, 1940.

This account of the characters, advantages and disadvantages of limes grown from seed and budded on stocks of other species of *Citrus* in St. Lucia, Dominica and Montserrat includes brief notes on the effect of insect pests, chiefly larvae of various species of *Diaprepes* that attack the roots. Seedling limes are fairly resistant to attack, but they are seriously harmed by unfavourable weather conditions, and since the extensive dying-out and destruction, by hurricane, of limes on their own roots in Dominica in 1928 and in St. Lucia and Montserrat during 1934–37, they have been largely replaced by budded trees.

As sour orange in nursery beds in St. Lucia and Dominica usually produces a strong tap root, it was thought that limes budded on it would be securely held in the soil. Trials established, however, that the tap-root does not persist after transplanting, and this is in part due to attack by larvae of *Diaprepes*, to which sour orange is not very resistant. The feeding tracks on healthy roots are quickly covered by callus, and secondary infestation by insects or fungi is not known to occur, but the relatively few main roots are generally so disposed that a small number of larvae feeding below the crown can girdle them in a few months, as a result of which the leaves turn yellow or fall. Where a plantation of interplanted seedling limes and limes budded on sour orange was subjected to successive attacks by larvae of *Diaprepes* over a long period, only the budded trees were seriously affected. In north-eastern Dominica and the uplands of southern St. Lucia, where the incidence of *Diaprepes* is lightest, scions on sour orange stock frequently die back, and this is believed in many cases to be hastened by infestation by *Lepidosaphes beckii*, Newm., and another Coccid, tentatively determined as *Pinnaspis minor strachani*, Cooley. Both species attack the lime scion, but do not cross the bud union to the sour orange stock, indicating a probable difference in vigour above and below the union, since sour orange is susceptible to attack by this species of *Pinnaspis*.

Of the other stocks, the resistance to larvae of *Diaprepes* of rough lemon in Montserrat and of bitter orange in moist habitats where the weevils are moderately abundant is about the same as that of sour orange, whereas that of Seville sweet orange is fairly high.

[LAVREKHIN (F. A.).] **Лаврехин (Ф. А.). The Fertility of Granary Weevils in Relation to different environmental Factors.** [*In Russian.*]—*Wiss. Ber. moskau. St. Univ.* no. 20 Zool. pp. 192–235, 8 graphs, 1 fig., 23 refs. Moscow, 1939. (With a Summary in English.) [Recd. 1940.]

A detailed account is given of a study in Moscow of the effect of various environmental factors on the fertility of *Calandra granaria*, L., and *C. oryzae*, L. Fertility is estimated as the number of eggs laid by a female within a unit of time that gave rise to larvae, pupae or adults. To ascertain this, the infested grains were dissected at the time of the appearance of the first adults among the offspring or a few days prior to this.

The following is largely taken from the author's summary: The temperature at which the numbers of offspring produced are greatest is between 25 and 30°C. [77–86°F.] in saturated atmosphere. At

temperatures above 30°C., the number of offspring begins to decrease, but even at 35°C. [95°F.] the fertility of the weevils is considerable. In the case of *C. granaria*, hardly any offspring were produced at a constant temperature of 9°C. [48·2°F.], but exposure for 25 minutes to about 45°C. [113°F.], or for 3½ hours to −6 to −9°C. [23–15·8°F.], did not affect fertility. The fertility of *C. granaria* was greatest in wheat of 17·5 per cent. moisture content ; it decreased when this content was 28 per cent., and reproduction practically ceased when it was only 8–9.

When reared in different kinds of grain, the number of progeny produced by *C. granaria* was greater in wheat and rye than in barley, and greater in barley than in oats. When supplied with mixed grains, both *C. granaria* and *C. oryzae* most readily attacked rye and wheat ; barley was less infested and oats scarcely at all. *C. granaria* showed decided preference for certain varieties of wheat, whereas others were only slightly infested. The fertility of *C. granaria* in oats was considerably greater if the husks had been removed, probably because they protect the grains from attack. In the case of barley, however, the presence or absence of the husks was unimportant.

The fertility of the weevils diminished as the density of their population increased, this decrease being subject to a definite law, which can be expressed graphically by the hyperbola $y=1\div(a+bx)$, where y is the number of offspring per female in a day, x is the population density, and a and b are constants. The effect of population density was the same, whether the population consisted of both *C. granaria* and *C. oryzae* or of only one of them. A reduction of the food supply from 100 to 10 grains per female resulted in a decrease in the number of offspring ; it is suggested that the perception by the female of a limitation of the food-supply exerts a negative influence on the physiology of reproduction.

In some parts of the Russian Union salt is mixed with grain to protect it from infestation. Experiments with *C. granaria* showed that the weevils do not readily oviposit in wheat when salt is mixed with it in the proportion of 1 : 50 by weight, and the number of progeny is much reduced. When supplied with grain of which half was mixed with salt and half was not, the weevils infested the latter considerably more than the former.

[Volkova (K. V.).] **Волкова (К. В.). Genetics of the Grain Moth.**— *C. R. Acad. Sci. URSS* (N. S.) **26** no. 6 pp. 604–606, 3 figs. Moscow, 1940.

The eggs of *Sitotroga cerealella*, Ol., are extensively used in the Russian Union for mass rearing of *Trichogramma evanescens*, Westw. In order to obviate the necessity for elaborate precautions to prevent the escape of the moths from the laboratory, and the consequent danger of infestation of grain, experiments were carried out in Moscow in 1938 to develop a non-flying strain. Ordinarily, *Sitotroga* is reared in test-tubes at a temperature of 23–26°C. [73·4–78·8°F.] and a humidity of 80–85 per cent., the breeding medium being wheat grain sterilised by steam and dusted with sulphur. The life-cycle lasts 1–1½ months, and 8–12 generations are obtained in a year.

The wings of a normal adult of *S. cerealella* are about 6·33 mm. long and well cover the body of the moth. By inbreeding, a strain was obtained in which they were 4·7 mm. long and did not cover the abdomen. Most of the females of this strain were unable to fly. In

experiments, however, in which normal males were subjected to treatment with X-rays and paired with normal females, and their progeny allowed to breed among themselves, a completely non-flying strain was obtained in which the wings were folded and measured only 3·7 mm. in length. Investigations on this strain showed that its fertility, vitality and rate of development were similar to those of normal individuals, and that no negative characteristics had been evolved. Grain infested by this strain of the moth was distributed to a number of laboratories in the Russian Union. Attention is now being devoted to breeding a strain with larger eggs and fewer scales, since the latter cause discomfort to the laboratory workers.

Sonan (J.). **Four new Species of the Ichneumon-Flies from Formosa (Hymenoptera).**—*Trans. nat. Hist. Soc. Formosa* **29** no. 190 pp. 201–204. Taihoku, 1939. [Recd. 1940.]

The four new Ichneumonids described include *Sinophorus psycheae*, bred from *Acanthopsyche taiwana*, Sonan, on tea.

Hayhurst (H.). **Insect Pests in Stored Products.**—Demy 8vo, xii + 83 pp., frontis., 48 pls. London, Chapman & Hall, Ltd., 1940. Price 15*s*.

This is a reprint, in book form, of a series of articles published in *Food* during 1939–1940, and is intended for the use of persons engaged in the manufacture, transport and storage of perishable goods, particularly foodstuffs. Unfortunately, it fails to provide a useful guide to insect pests of stored products. The descriptions are inadequate, and most of the photographs are poorly reproduced, often making the insect unrecognisable. No authority is given for the determination of the species, and several records are doubtful. Thus, five species of *Cryptophagus* are mentioned, including *C. fowleri*, Joy, and *C. pallidus*, Sturm, which are synonymous and not yet recorded as pests in this country, while no mention is made of several other species of the genus commonly found in stored products. The figure of *Ptinus subpilosus*, Sturm (plate 2, fig. 7) represents a female of *Ptinus fur*, L. and there are at least three other species of *Ptinus*, more important than *P. subpilosus*, that are not mentioned. The section on control measures is very brief and of little practical value, since only vague recommendations are made. The lack of a bibliography suggests that the introductory statement on the scarcity of literature dealing with pests of stored products was probably made in ignorance of the many excellent works on the subject. The high price of the book is presumably due to the uneconomical arrangement of the illustrations on the 48 plates. It cannot be said to be useful to an entomologist, and it may be actually misleading to a layman.

Ullyett (G. C.). **The Species of *Aphidius* (Aphidiinae : Braconidae) as Parasites of Aphids in South Africa.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 178, 28 pp., 9 figs., 6 refs. Pretoria, 1938. [Recd. 1940.]

The most important parasites of Aphids in South Africa are Braconids of the genus *Aphidius*, which are common and usually obtainable throughout the year from colonies of Aphids. Since species of *Aphidius* from different parts of the world are often very closely

related morphologically, so that it is difficult to decide whether they are identical or not, most of the South African species remain undetermined or undescribed. Their life-cycles and habits are, however, very similar, and are described for the genus as a whole in this paper, which records the results of one section of a preliminary survey of the factors contributing to the natural control of Aphids in South Africa. The morphology of the larvae and adults is described, the former in some detail, and the systematic position of the genus, which shows some affinities with other families, is discussed.

Females of *Aphidius* deposit a single egg within the body of the Aphid, but an individual host may receive several eggs at different times, since they are deposited at random through the entire Aphid population. As many as 8 larvae have been found in a single host, but only one of these is able to mature. Females are capable of laying 300–400 eggs. The larva feeds on the body-fluids and fat-body of the host, and passes through 3 instars, the larval stage lasting about a week in warm weather. The Aphid is killed as the parasite larva matures. The parasite then cements the body of the host to the leaf or stem on which it rests, and pupates within its hardened skin, emerging as an adult within a few days. Males are slightly more numerous than females. Adults survived for as long as 3 weeks in the laboratory when fed on sugar, water and raisins, but the average longevity was about 2 weeks. Aphids parasitised in the first two instars do not become adult ; those parasitised before the end of the third instar reach the adult stage, but are unable to reproduce, while the number of progeny produced by those attacked later is very considerably reduced. In general, each species of Aphid appears to be attacked by a particular species of *Aphidius* ; in some cases two or more species attack the same host, and rarely a single species of *Aphidius* may attack more than one host species.

Conditions for the reproduction of *Aphidius* in a colony of Aphids are favourable until migration occurs, when the parasites emerging from Aphids that remain behind must search for new colonies on other plants, and those carried by migrants may have only a limited supply of material for oviposition if the parasitised Aphids reproduce, or may have to search for new colonies if the hosts die without reproducing. It is shown by a calculation based on typical figures that owing to the respective rates of reproduction of parasite and host, and to the fact that some of the parasitised Aphids reproduce, *Aphidius* would be unable to reduce the Aphid population appreciably until the latter had passed through several generations and done economic damage, even if the development of the parasite population was not interrupted. Climate appears to be one of the important factors restricting the activity of the parasite, which is more affected by the low temperatures of winter than is its host. It is, therefore, more likely to effect control in the warmer parts of the country, where it is able to build up its population over a longer period.

Aphidius is itself attacked by a few parasites ; *Charips* spp., which also occasionally occur as primary parasites of the Aphids, are the most numerous. Females of these Cynipids oviposit in the larvae of *Aphidius* towards the end of the first instar or the beginning of the second. The Braconid larva dies after it has cemented the body of the Aphid to the leaf or stem of the plant, and the pupal stage of the hyperparasite is passed inside the dried skin of the Aphid. *Charips* spp. become increasingly common towards the end of summer, at

which time as many as 80 per cent. of the larvae of *Aphidius* dissected from their hosts have been found parasitised. Pteromalids are ectoparasitic on the larvae of *Aphidius* in certain species of Aphids, such as *Anuraphis persicae-niger*, Smith, and sometimes attack *Aphidius* larvae parasitised by *Charips*. The general effect of such multiple parasitism is unknown, but in most cases the Aphid, parasite and hyperparasite appear to be killed. The Aphids are attacked by large numbers of predacious insects, which devour parasitised and healthy Aphids indifferently. A large proportion of the parasite population may, therefore, be destroyed. The development of *Aphidius* does not seem to be affected by competition with Chalcidoid primary parasites, since the latter are not normally very plentiful, and when the two parasites occur in the same host, the larva of *Aphidius* develops at the expense of the Chalcidoid. Most of the insects that feed on the secretions of the Aphids do not affect their parasites and predators, but ants disturb ovipositing females of *Aphidius*. It is concluded that, owing to the overwhelming limitations to which *Aphidius* is subject, it would be impossible to manipulate the indigenous species to gain better control of Aphids.

MOORE (E. S.) & ANDERSSEN (E. E.). **Notes on Plant Virus Diseases in South Africa. I. The Kromnek Disease of Tobacco and Tomato.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 182 pp. 1–36, 13 pls., 2 diagrs., 11 refs. Pretoria, 1939. [Recd. 1940.]

An account is given of the distribution in South Africa of the kromnek disease of tobacco and tomato [*cf. R.A.E.*, A **21** 583]; studies of material from three different parts of the Union showed that the virus was the same in all of them, and, although direct comparisons have not been made, it is considered that it is probably identical with the virus of spotted wilt [*cf.* **27** 546, etc.]. The disease has recently become prevalent in the Transvaal, where it has caused heavy losses of tomatos and is a potential danger to the tobacco industry. Its symptoms in a number of plants are described.

The species of *Frankliniella* that transmits the virus in South Africa and is the main vector in eastern Cape Province [**21** 583] has been identified as *F. schultzei*, Trybom. It is apparently one of the most widely distributed thrips in South Africa, and has been found in most of the localities in which the disease occurs. A list is given of 40 plants, most of which are cultivated, on which it has been taken; it is known to breed, however, on only 6 of them, including tobacco and tomato. Its life-history was studied on tomato plants out-of-doors; the cages used for the purpose are described. The female deposits its eggs singly below the epidermis of the upper surface of the leaf over a considerable period. They hatch in 4 days in summer and 7–8 days in cold weather. The larvae emerge from the leaf tissue and begin to feed almost immediately. They are gregarious. The prepupal stage is brief, sometimes lasting less than a day, and the pupal stage, which is passed on the plants or in débris, lasts 2 days or more. The adults survived for as long as 3 months in breeding cages in cold weather, but for a much shorter time during summer. They are very active in hot weather. They prefer to feed on the flowers of some plants [*cf.* **21** 584] on which the blooms are large, but on others, such as tomato, they feed mainly on the foliage. Tomato seems to be particularly attractive and is often attacked and killed in the seedling

stage. Parthenogenetic reproduction commences a few days after adult emergence. The proportion of females to males is about 6 : 1. A single female gave rise to 20 larvae in a breeding cage, but the number is probably much greater under natural conditions.

Adults survived temperatures ranging from 14 to 108°F., but became dormant at temperatures below 50°F. Little or no feeding takes place during cold weather, but there is no true hibernation, and feeding and reproduction are resumed as soon as the temperature permits. On several occasions, peaks in the field population occurred at approximately 30-day intervals. The minimum period for one generation is probably 18 days. The thrips thrive in hot, dry weather, but are destroyed by rain. Their numbers are not materially reduced, however, unless rain continues for several days. The adults hide during rain and high winds, but are spread considerably by light breezes. Field observations at regular intervals during a year showed that the population on different food-plants fluctuates in a manner that suggests migration from one plant to another. No natural enemies have been observed.

In laboratory studies on the transmission of the virus of kromnek, [*cf.* **21** 584], healthy tomato plants were inoculated with the virus, and, when definite symptoms of disease appeared, adults of *F. schultzei* were caged on individual leaves for a few days. Their offspring were bred on the same plants until they were required for tests, when they were allowed to feed for 24 hours on a confined area of the leaf of an uninfected plant. The transmission cage is described. A considerable proportion of successful transmission to tomato, tobacco and *Datura* by adults was obtained and two instances of transmission by larvae in the last instar, but in over 100 tests with larvae up to 6 days old, the virus was transmitted only 3 times.

The reasons for the erratic incidence of kromnek disease in tobacco in the Kat River Valley are discussed from records made during the 4 seasons 1933–1937. The extremely low rate of infection during 1934–35 was probably the result of the abnormally dry and severe winter of 1934, which destroyed many of the winter food-plants of the thrips, with the result that its peak population was not reached until late summer. Some of the plants on which the thrips breed survive the winter and are known or suspected reservoirs of the virus. Such plants are probably the source of spring infections. In some seasons tobacco is little affected by the disease, although appreciable numbers of *F. schultzei* are present, but tomatos grown in open situations are commonly infected, apparently because the leaves of tomato are preferred to those of tobacco. Of 171 thrips taken on tobacco during 6 weeks in December 1933 and January 1934, only one was *F. schultzei*, whereas of 500 from tomato only 3 yards away, 468 were of this species. *F. schultzei* is the only thrips infesting tobacco foliage that has been proved to transmit the virus, and on several occasions in 1931 and 1932 its sudden appearance in seedbeds was followed by outbreaks of disease.

Thrips tabaci, Lind., which transmits the virus of spotted wilt, is widely distributed in South Africa, and has been associated with outbreaks of kromnek disease in certain areas of the Transvaal. In the laboratory, the virus was transmitted in a few cases by both larvae and adults. A list is given of 11 plants on which *T. tabaci* has been observed in a market garden area in the Transvaal, including 6 on which it breeds, and it was reared in the laboratory on a further 5. It

breeds less readily on tomato than on other food-plants. A serious outbreak of kromnek disease occurred near Pretoria in October 1933 in commercial plantings of tomatos grown after winter crops of onions, cabbage and cauliflower, on which the thrips feed during the winter. Investigations on the irregular incidence of the disease in tomatos in the market-garden area during the 4 seasons 1933–1937 indicate that it is correlated with the relative size of a thrips population consisting mainly of *T. tabaci*. No correlation was found with climatic conditions at the time of outbreak or in the preceding months. The source of infection in years of epidemics is unknown, and no practicable method of controlling the disease under field conditions was found.

Ripley (L. B.), Petty (B. K.) & van Heerden (P. W.). **Further Studies on Gustatory Reactions of the Wattle Bagworm, (*Acanthopsyche junodi*, Heyl.).**—*Sci. Bull. Dep. Agric. S. Afr.* no. 205, 20 pp., 8 graphs, 4 refs. Pretoria, 1939. [Recd. 1940.]

Experiments on the gustatory reactions of larvae of the wattle bagworm, *Acanthopsyche junodi*, Heyl., with reference to dusted foliage [*R.A.E.*, A **25** 102] were continued in South Africa in 1936–39, using the methods previously described, as well as a new one in which gustatory responses are determined directly from selection by the larvae of foliage of wattle (*Acacia*) treated in different ways. Tests on the reactions of the larvae to powdered glass showed that all instars reacted in the same manner to particles of a given size, the degree of repellence decreasing gradually as the size of the particles decreased. Particles over 10 microns in diameter repel normal larvae considerably, the degree of reaction varying with the physiological state of the larvae. The practical advantage of using particles less than 5 microns in diameter is doubtful, as the reduction of repellence gained by using finer dusts is relatively small.

To determine the practical effect of particle size on the efficacy of cryolite dusts, experiments were carried out with synthetic cryolite, in which the chemical composition remains practically the same for all degrees of fineness. It was found that particles averaging 2·3 microns in diameter gave considerably higher and quicker mortalities than those of 7·9 microns, the former causing 8–25 per cent. higher mortality than the latter. Owing to the greater rate of solubility of the finer dusts, toxicity appeared to be at least as important as repellence in determining the efficacy according to particle size.

The sensitiveness of the larvae to dusted foliage varies markedly according to their physiological state. Newly collected individuals, which are usually well fed, do not feed so readily as slightly hungry and slightly thirsty ones, and are much less sensitive. Larvae that are too hungry or too thirsty, however, are noticeably less selective, and are not repelled by even the coarsest particles. Increased feeding caused by very fine dusts [*cf. loc. cit.*] occurred relatively late in some experiments, and may have been due to increased thirst caused by the fine dust or to irritation.

Experiments in which various tastes and odours were imparted to wattle foliage by dipping it in weak solutions and then drying it showed that most sugars have little or no effect on either sensory response or the amount of feeding. Salts in general repel the larvae, though alum (3 per cent.) is weakly attractive and bismuth carbonate (1–3 per cent.) strongly attractive. Magnesium sulphate and alum

decrease feeding, but sodium chloride, which is a repellent, and bismuth carbonate increase it. Acids generally cause a marked increase in feeding, whether they attract (acetic, citric and mallic acids) or repel (tartaric and oxalic acids). Tannic acid, however, is attractive but decreases feeding. *Acacia* flower oil and chemicals with a similar odour, especially those occurring in the oil, are strongly attractive and increase feeding, the high degree of sensitiveness to such chemicals suggesting that essential oils, aldehydes, alcohols and esters may be of importance in the selection of the food-plant. The difference in the degree of infestation of different species of *Acacia* [*cf.* **21** 35 ; **22** 352] probably depends on such factors as the time of flushing and recuperative powers of each species, nutritional factors, and variations in the biotic complex in different environments, as well as on the sensory response. Physical factors concerned in the relative attractiveness of the species include water content and hardness of the leaflets. There is a striking preference for leaves with a higher water content and also for freshly flushed rather than old foliage, even when the water content of the old foliage is at least as high as that of the new.

Naudé (T. J.), Ripley (L. B.) & Petty (B. K.). **Wattle Bagworm Control by Aeroplane Dusting.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 206, 12 pp. Pretoria, 1939. [Recd. 1940.]

Though the control of *Acanthopsyche junodi*, Heyl., on wattle (*Acacia*) in South Africa by dusting with natural cryolite applied with power dusters is practical and economically sound over limited areas, dusting the whole of a wattle belt presents various economic difficulties. Unless all the dusting in a given district is completed within 3 weeks, the amount of cryolite used must be doubled to kill the larger larvae, and in most cases this would be too expensive.

An account is given of investigations on the practicability of dusting from an aeroplane, carried out in October 1937 over an area of 750 acres near Pietermaritzburg containing heavily infested *Acacia mollissima* and *A. decurrens*. It was desired to apply the dust of natural cryolite at the rate of about 30 lb. per acre, but owing to technical difficulties the rate actually varied from 16 to 39 lb., the latter being obtained by two flights over the same ground. The percentage larval mortalities on the fourth, seventh and twelfth days after dusting were 61–76, 69–93 and 92–97, which was considered highly satisfactory. The lowest rate of application was as effective as the highest, and, as a result, the rate recommended is 20 lb. per acre, which is as effective when applied from the air as one of 30 lb. or more applied from the ground. Although the weather conditions at the critical time of year are not favourable, it seems likely that on the average a sufficient number of clear days can be relied on to enable the work to be done in good time and without excessive additional flying costs.

Ripley (L. B.), Hepburn (G. A.) & Dick (J.). **Mass Breeding of False Codling-Moth, *Argyroploce leucotreta* Meyr., in artificial Media.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 207, 18 pp., 6 refs. Pretoria, 1939. [Recd. 1940.]

In view of the necessity for a ready supply of the false codling moth, *Argyroploce leucotreta*, Meyr., for investigations in South Africa on the olfactory reactions and migration of the adults and the rearing

of parasites, and the impracticability of breeding the Tortricid in sufficient numbers in orange fruits, experiments were carried out on the use of an artificial medium. The technique evolved, which permits large numbers of moths to be reared at all times of the year, is described in detail.

When the larvae were bred in an oatmeal porridge under aseptic conditions, they gave rise to adults that were normal in behaviour and longevity but slightly undersized and subnormal in fecundity and the viability of their eggs. To obtain satisfactory reproduction and rate of growth, it was necessary to supply certain nutritional needs by the use of living moulds or yeasts, of which *Mucor hiemalis* was the best. The larvae developed faster in media containing *M. hiemalis* or *Penicillium acidiferum* killed by autoclaving at 126°C. [258·8°F.] than in the sterile medium, but both the rate of larval growth and reproduction in the resulting adults were much lower than in media containing living moulds. Cannibalism, which was prevalent in the sterile medium, was greatly reduced when *M. hiemalis* was established on the medium before the eggs hatched. The addition of various salts and sugars to the oats and the use of milk instead of water did not improve the original medium, but mixing beef extract with the oats increased the rate of growth and nearly doubled the fecundity. Its use, however, was found superfluous in the medium finally evolved.

BRITTON (W. E.). **Connecticut State Entomologist, Thirty-eighth Report, 1938.**—*Bull. Conn. agric. Exp. Sta.* no. 428, 122 pp., 16 figs. New Haven, Conn., 1939. [Recd. 1940.]

An annotated list is given by W. E. Britton (pp. 7–22) of insect pests observed in Connecticut in 1938, and work in the campaign against the gipsy moth [*Lymantria dispar*, L.] is reported by Britton, J. T. Ashworth and O. B. Cooke (pp. 41–49). Britton, M. P. Zappe and N. Turner (pp. 50–53) state that infestation by the European corn borer [*Pyrausta nubilalis*, Hb.] on both early and late sweet maize was severe throughout the State; early potatoes were heavily infested in one county and late potatoes in two. Continued trials with a commercial dual-fixed nicotine dust containing 3·75 per cent. nicotine on early sweet maize indicated that it may be possible to reduce the number of applications in the standard schedule [*R.A.E.*, A **27** 179] against larvae of both generations. The standard schedule gave highly satisfactory results against the second-generation larvae, 70·2 per cent. of the ears being uninfested, as compared with 18·5 per cent. on untreated maize.

J. P. Johnson (pp. 53–58) states that adults of the Japanese beetle [*Popillia japonica*, Newm.] were more abundant than in the previous year; they occurred in 11 towns hitherto free and alighted in large numbers on boats in the western end of Long Island Sound.

P. Garman (pp. 65–68) gives an account of work on biological control during the year. Parasites of the oriental fruit moth [*Cydia molesta*, Busck] reared in the laboratory comprised *Trichogramma pretiosum*, Riley, the larval parasites, *Angitia* (*Dioctes*) *molestae*, Uch., *Orgilus longiceps*, Mues., *Macrocentrus ancylivorus*, Rohw., and *Microdus* (*Bassus*) *diversus*, Mues., and the pupal parasite, *Phaeogenes haeussleri*, Uch. The number of larval parasites produced was 19,379 or less than one-third of that reared during the previous year [**26** 724], owing to

the depredations of *Pediculoides ventricosus*, Newp., which attacked both host larvae and parasites. Studies on the factors responsible for the unfavourable sex ratio in reared adults of *A. molestae* indicated that selection of breeding stock was important, and that a higher proportion of females was produced when both sexes were crowded in small cages. Experimental liberations of large numbers of *Trichogramma pretiosum* were made in three commercial orchards, but heavy rains probably destroyed the emerging parasites and the percentages of eggs parasitised slightly exceeded that in control orchards in only one case. Recoveries of *Microdus diversus* were made in one district in which it has now survived for two years and in another where other parasites have failed to survive. *A. molestae* survived the winter in considerable numbers in one district and parasitised 6·1 per cent. of the larvae during July in an orchard in which *Macrocentrus ancylivorus* parasitised 13·2 per cent. No recoveries of *O. longiceps* were made, and the breeding and liberation of this species were discontinued.

In the course of work with parasites of *Popillia japonica*, 15 colonies of *Tiphia vernalis*, Rohw., were liberated in 9 localities, and 18 of *T. popilliavora*, Rohw., in 12. *T. vernalis* was again recovered from all the points at which it was released in 1936, but from none of those at which it was released in 1937; in one district, about 33 per cent. of the larvae examined were parasitised by it. *T. popilliavora* was recovered from several localities in which it was released in 1937, and it is considered to have become established. Adult beetles parasitised by *Centeter cinerea*, Aldr. [*cf.* **26** 723] were trapped on 25th June and 5th July, but none was observed later in the summer.

M. P. Zappe & E. M. Stoddard (pp. 68–71) describe investigations on sprays against insects attacking apple. The lead arsenate in these sprays was used at the rate of 3 lb. per 100 U.S. gals. Schedules comprising 5 applications of sprays containing lead arsenate and Coposil (copper aluminium silicate), copper phosphate or copper oxychloride followed by one application of lead arsenate and lime were less effective in controlling insect injury on two varieties susceptible to scab than others in which sprays containing lead arsenate and dry flotation sulphur or dry lime-sulphur were used for the first five applications; furthermore, the copper compounds injured the foliage and caused the fruit to russet. Curculio [*Conotrachelus nenuphar*, Hbst.] was least injurious in a plot that received 3 applications of the dry lime-sulphur and lead arsenate spray followed by 2 of a spray containing lead arsenate, lime and fish-oil [**26** 723] and 1 of lead arsenate and ime. On varieties less susceptible to scab, *C. nenuphar* and other chewing insects were again well controlled by the spray of lead arsenate, lime and fish-oil; the most serious injury was caused by the rosy aphis [*Anuraphis roseus*, Baker].

A series of papers by Garman deals chiefly with the control of orchard pests (pp. 72–79). The promising results given by rotenone dusts against the apple maggot [*Rhagoletis pomonella*, Walsh] in 1937 [**26** 725] were not repeated in 1938, when high temperatures and heavy rainfall rapidly destroyed the rotenone, thereby enabling the females to oviposit heavily. In laboratory tests against *Aphis rumicis*, L., the addition of Karaya gum to sprays containing nicotine sulphate and sodium oleate appreciably increased their effectiveness, but it did not increase the effectiveness of nicotine sulphate without the wetting agent. Injury to peaches by *Cydia molesta* was rather less on trees

that received one application of a dust containing lead arsenate, lime, talc, sulphur and oil followed by three of a similar dust from which the lead arsenate was omitted than on others receiving four weekly applications of a nicotine-bentonite spray, but neither treatment gave satisfactory control. Measures against insects infesting quince, including *C. molesta* and the quince curculio [*Conotrachelus crataegi*, Walsh], were investigated over a period of 5–6 years in a small planting in a district where damage to over 90 per cent. of the fruits of untreated trees is usual. The best results were obtained in 1934 on a tree that was sprayed three times at monthly intervals, beginning in late May, with lead arsenate and dry lime-sulphur and then covered with tobacco cotton from the beginning of August until harvest; 86·8 per cent. of the fruits produced were uninjured. In 1935, 83·9 per cent. uninjured fruit was given by monthly applications of a spray containing lead arsenate, dry lime-sulphur and casein-glue during June, July and August; inspection during the summer showed that control was frequently good until the end of August or the beginning of September. When monthly applications of lead arsenate and dry lime-sulphur in May, June and July 1934 were followed by 6 applications of a spray containing derris and skim milk powder between 9th August and 11th September, 80 per cent. of the fruits were uninjured. In 1937, when a schedule (lead arsenate, lime and fish-oil) that did not include lime-sulphur was employed, only 11·4 per cent. of the fruits were free from injury. The dilutions of the various materials in 100 U.S. gals. were as follows: lead arsenate, 3 lb.; dry lime-sulphur, 4–6 lb.; casein-glue, 0·5 lb.; skim milk, 1 lb.; and fish oil, 1 U.S. quart.

B. J. Kaston & D. S. Riggs (pp. 80–88) give an account of a survey of the populations of *Scolytus multistriatus*, Marsh., and *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., in elm trees in western Connecticut during June–September. The results indicated that although *S. multistriatus* is widely distributed, it represents only about 9·5 per cent. of the total elm bark-beetle population throughout most of the area; in the southern part of New Haven County, however, it constitutes 33·6 per cent. Neither species breeds in healthy parts of the tree. The most favourable conditions are provided by limbs that have died very recently; wood that has been dead for more than a year, or at most two, is unsuitable for breeding, chiefly as a result of the drying out of the bark, but sometimes also because of heavy growths of fungi and increasing competition with larvae of other borers, notably *Eutetrapha* (*Saperda*) *tridentata*, Ol. Large shaded branches remain attractive longer than small exposed ones. *Scolytus* exhibits a greater adaptability to variation in conditions of moisture, and breeds in small branches much more commonly than *Hylastes*. The density of *Hylastes* is lowest in limbs of small diameter, whereas that of *Scolytus* is at least as great in small limbs as in large.

Johnson (pp. 89–91) gives an account of the bionomics of *Cyclocephala* (*Ochrosidia*) *borealis*, Arr. (*villosa*, Burm., nec Blanch.). This Dynastid was first reported from Long Island, where it was damaging a lawn, in 1935, and during 1936–37 it attacked lawns in three other places in Connecticut. Its range in the United States extends southward to Alabama and westward to Kansas and Nebraska; in the last two States the larvae have occurred in fields of maize, wheat and oats, as well as in turf. In the insectary, the numbers of eggs deposited by individual females ranged from 3 to 29 and averaged 11–12. In the field, most eggs were laid at a depth of $4\frac{1}{2}$–6 ins. below the surface of the

soil. There are three larval instars. Third-instar larvae were observed in the field on 7th September, and populations of 64, 33 and 48 per sq. ft. were recorded. The larvae hibernate at varying depths, some descending as deep as 18 ins. On 12th April, before the upward movement had begun, 11 larvae were found in the upper 3 ins. of soil, 19 at a depth of 3–9 ins. and 1 at 9–12 ins. Of a total of 61 larvae collected for the determination of winter mortality, 30 were dead, and observations elsewhere also indicated that the mortality was high. Pre-pupae and pupae were present in one district on 14th June ; most of the pupae occurred at depths between $3\frac{1}{2}$ and 5 ins. The egg, pre-pupal and pupal stages last about 20–22, 7 and 18 days, respectively. Adults were first caught in light-traps placed 30 ins. above the ground on 25th June, and the last on 25th July. Four traps caught 18,967 from an area approximately 3 acres in extent ; the maximum catch (3,924) was on 5th July. The adults are active from dusk until about 10.30 p.m., except during rain or on cool nights, the males flying at heights of 1–2 ft., and the females usually occurring on the tips of the grass blades or on the ground. Of over 9,000 adults taken in two traps and examined for sex, 99·63 per cent. were males. The adults did not appear to injure grass or foliage, their mouth-parts being rudimentary. Applications of lead arsenate at a rate of not less than 2 lb. per 100 sq. ft. were recommended as a control measure against the larvae, and excellent results were observed in early spring and summer in lawns to which lead arsenate had been applied at the rate of 3 lb. per 100 sq. ft. during the previous autumn [*cf.* also **26** 729].

G. H. Plumb & R. B. Friend (pp. 98–102) describe an outbreak of *Ennomos subsignarius*, Hb., that occurred in June 1938 in south-western Connecticut, where deciduous trees in two areas of woodland were defoliated. This Geometrid was more abundant in New England before 1890 than subsequently, and outbreaks have not hitherto occurred in Connecticut, although they were recorded in neighbouring States in 1907–10 and 1914–17. It has one generation a year. Eggs are deposited in masses on the bark in mid-summer, and the larvae appear when the leaves begin to open in spring. On 14th June, the larvae were beginning to pupate ; the pupae occurred in folded leaves, hanging loosely from the twigs, or in masses of leaf fragments caught together with silk and sometimes extending in trails from ground level to high up on the trunks. Adults were observed 11 days later. The defoliated areas were both situated in a low swampy valley. In the drier of two quadrates marked out for observation, red maple [*Acer rubrum*], white ash [*Fraxinus americana*] and yellow birch [*Betula lutea*] were dominant, and the first two appeared to be the preferred food-plants, although *B. lutea* and 10 other species were attacked to varying degrees. In the wetter area, where *A. rubrum* and American elm [*Ulmus americana*] were dominant, all the trees, including *B. lutea* and three other species, were completely defoliated. During 1914–18, *A. rubrum* in swamp land in Massachusetts was almost completely destroyed as the result of defoliation in two or three successive years, but in Connecticut most of the trees, except a number of elms, produced new foliage later in the year. Parasites reared from pupae of *E. subsignarius* were *Pimpla* (*Ephialtes*) *conquisitor*, Say, *P.* (*Epiurus*) *indagatrix*, Cress., and a Chalcid ; *Dibrachys cavus*, Wlk. (*boucheanus*, Ratz.) was hyperparasitic on *P. conquisitor*. About 69 per cent. of the pupae were parasitised, many containing a Dipterous larva tentatively determined as a Tachinid.

Miscellaneous pests on which notes are given by several of the above authors (pp. 105–112) include *Blissus hirtus*, Montd., which, despite cold wet weather in May, caused considerable damage to lawns ; *Aserica* (*Autoserica*) *castanea*, Arr., which was first recorded in 1928 in the south-western part of the State and has in recent years become more prevalent in several coastal towns ; *Forficula auricularia*, L., which was reported in Connecticut for the first time, two examples being found in a garden ; *Malacosoma disstria*, Hb., which was locally very abundant in north-western Connecticut during May and June 1938, defoliating sugar maple [*Acer saccharum*] and oaks ; and *Anobium punctatum*, DeG., which severely damaged wooden antiques and modern oak display cases in a museum. *Rhyncolus* (*Hexarthrum*) *ulkei*, Horn, caused serious injury to woodwork in a basement, and damaged basement stairs, in which *Xestobium rufovillosum*, DeG., also occurred, in a second building, and sheathing, which was also infested by termites, in the lower part of a third. The painted surface of wood attacked by *R. ulkei* was undamaged, but the inside was reduced to a fine powder.

Larvae of *Anomala orientalis*, Waterh., destroyed 2–3 acres of the turf and damaged many smaller areas in a hay-field. This Rutelid was first recorded in Connecticut in 1920 and has not hitherto been observed attacking hay-fields or pastures. Peach trees in an orchard where the young fruits were being attacked by large numbers of *Macrodactylus subspinosus*, F., were treated on 16th June with sprays containing 2 lb. lead arsenate, 4 lb. zinc sulphate, 6 lb. lime and 10 lb. flotation sulphur paste in 100 U.S. gals. water or 10 lb. cubé powder, with skim milk spreader, in 100 U.S. gals. water. A week later there were no adults on 50 trees treated with lead arsenate, 8 on 22 trees treated with cubé, and 70 on 50 unsprayed trees. In a private garden, only partial control was given by 2 lb. cubé powder and 1 lb. pyrethrum powder in 100 U.S. gals. water applied over an area approximately 30 ft. square. The beetles were caught in fairly large numbers in traps set up for *Popillia japonica* during June and early July, but many were observed in the immediate vicinity of the traps, which, in cases of severe infestation, should be placed several feet away from preferred food-plants to avoid excessive feeding on the foliage or flowers.

Entomology and Zoology.—*Rep. S. Carolina Exp. Sta.* **51** (1937–38) pp. 63–73, 7 diagr. Clemson Coll., S.C., 1938. [Recd. 1940.]

Insect pests were in general normally abundant in South Carolina during 1938. O. L. Cartwright reports that the dust of finely ground natural silicic acid, which in preliminary tests [*cf. R.A.E.*, A **26** 644] had given promising results against the rice weevil [*Calandra oryzae*, L.] in stored maize, failed in further tests to control insects in stored maize, wheat, and peas. A survey of conditions throughout the State just before harvest showed that the average percentages of maize cobs infested by different insects were 27·92 by *C. oryzae*, infestation being most severe in the central and coastal areas ; 93·86 by the corn earworm [*Heliothis armigera*, Hb.], which damaged 84·15 per cent. of cobs ; 61·15 by the pink cornworm [*Pyroderces rileyi*, Wlsm.] ; 31·54 by the angoumois grain moth [*Sitotroga cerealella*, Ol.] ; and 57·71 by flour beetles. *P. rileyi* and the flour beetle, *Cathartus cassiae*, Reiche, each infested over 75 per cent. of the cobs of maize grown in the lower half of the State. In general, infestation of peach by the oriental fruit

moth [*Cydia molesta*, Busck] was heavier than during the two preceding years [*cf.* **25** 630; **26** 644], but though moderately severe twig injury developed, the percentage of fruits injured averaged only about 2, with a maximum of 15 in one orchard. Four colonies of the pupal parasite, *Phaeogenes haeussleri*, Uch., and 25 of the larval parasite, *Macrocentrus ancylivorus*, Rohw., were released in peach orchards; the percentage parasitism by *M. delicatus*, Cress. [*cf.* **25** 630] reached 65·62 in one orchard by 15th July.

F. Sherman and J. N. Todd record investigations in 1938 on the bionomics of *Chalcodermus aeneus*, Boh., on cowpeas; they showed that eggs deposited on 1st July, 1st August and 1st September gave rise to adults in about 4, 3 and 6 weeks, respectively. Later in the season, development lasts over 2 months. Oviposition continued from 1st July to mid-October, the peak being reached on 16th August. Two generations of the weevil were bred in the laboratory, but only 40 per cent. of the first-generation adults and none of the second oviposited during the current season. In laboratory tests, low mortalities were given by dusts of undiluted magnesium arsenate, calcium arsenate and lead arsenate, while sprays of synthetic or natural cryolite or derris were ineffective. Paris green caused severe scorching of the foliage, and foliage injury resulted from the use of all the arsenicals in field tests. Since the weevil is most destructive to early planted cowpeas, it is suggested that commercial control might be obtained by delayed planting.

Bondy (F. F.) & Rainwater (C. F.). **Boll Weevil and miscellaneous Cotton Insect Investigations.**—*Rep. S. Carolina Exp. Sta.* **51** (1937–38) pp. 114–125. Clemson Coll., S.C., 1938. [Recd. 1940.]

In 1938, infestation of cotton by the boll weevil [*Anthonomus grandis*, Boh.] in South Carolina was the heaviest for many years, and various methods of control were investigated. The results have already been noticed [*cf. R.A.E.*, A **28** 360, 473]. Observations covering a period of 7 years have shown that of weevils kept in hibernation cages, approximately 80 per cent. emerge in May and 20 per cent. in June and July, the latest recorded date of emergence being 12th July, in 1937; records in 1937 from a trap crop, however, indicated that weevils emerge later and over a longer period in nature than in cages. The large number of weevils coming into the cotton fields after 15th June, the latest date when pre-square treatment is effective, multiply rapidly under favourable conditions and cause the increase in population that makes dusting necessary in late July and early August.

Tests on the cotton leaf Aphid [*Aphis gossypii*, Glov.] indicated that a dust containing equal parts of tobacco dust and sulphur with the addition of sufficient derris to give the mixture a rotenone content of 1 per cent., applied at the rate of 11·2 lb. per acre, or one of cubé and sulphur containing 1 per cent. rotenone and applied at the rate of 18·4 lb. per acre, gave satisfactory control if the plants were wet at the time of application. A dust of 2 per cent. nicotine sulphate and lime at the rate of 9·2 lb. per acre killed the Aphids more quickly, but did not give satisfactory control as it remained effective for a much shorter period of time.

Allen (N.), Humphreys (J. W.) & Lieux (D. B.). **Experiments with Insecticides as a Control for the Tomato Worm and Flea Beetle on Tobacco.**—*Rep. S. Carolina Exp. Sta.* **51** (1937–38) pp. 136–144, 6 figs. Clemson Coll., S.C., 1938. [Recd. 1940.]

The following is based on the authors' summary and conclusions: Small-scale experiments in South Carolina in 1938 indicated that where insecticides were applied to tobacco plants at a point high enough to kill larvae of *Protoparce sexta*, Joh., the kill of the flea-beetle, *Epitrix parvula*, F., was less than that obtained in previous years when the insecticide was applied lower on the plants for the control of the latter. A synthetic cryolite dust mixture containing 80 per cent. sodium aluminium fluoride with a commercially prepared finely ground diatomaceous earth as diluent, and a spray of 6 lb. synthetic cryolite (85 per cent. sodium aluminium fluoride) in 50 U.S. gals. water, both proved highly effective against *P. sexta*, irrespective of the size of the larvae at the time of treatment. Effective control of the flea-beetle was obtained by a thorough application of a cubé dust containing 1 per cent. rotenone [*cf. R.A.E.*, A **26** 645].

Watts (J. G.). **Insect Control Studies.**—*Rep. S. Carolina Exp. Sta.* **51** (1937–38) pp. 189–194. Clemson Coll., S.C., 1938. [Recd. 1940.]

Investigations during 1938 at the experiment station newly established at Edisto were chiefly concerned with *Crioceris asparagi*, L., the only serious pest of asparagus in South Carolina. Eggs are normally laid on young spears during the cutting season, and later on the stems and foliage. Little injury is caused to the spears, owing to the frequent cutting, but that caused by the feeding of adults and larvae on the ferns after harvest is serious, though not apparent until the following spring. No effective control was given by leaving 1, 2 or 3 rows in square one-acre plots uncut to attract the adults, and dusting them with calcium arsenate every other day. Experiments with various insecticidal dusts, the composition and order of efficiency of which are shown in a table, indicated that all were more effective against the larvae than against the adults; no change from the practice of dusting with undiluted calcium arsenate, or calcium arsenate and lime (1 : 4), is recommended. Natural enemies of the larvae included a Tachinid parasite, *Stomatolydella infernalis*, Tns., the Pentatomid, *Stiretrus anchorago*, F., and Reduviids of the genera *Sinea* and *Pselliopus*. On a few occasions, the Coccinellid, *Hippodamia convergens*, Guér., was found feeding on the eggs and very young larvae. Corn budworms [larvae of *Diabrotica duodecimpunctata*, F.] commonly cause serious damage to newly germinated maize in moist land; the results of investigations on the effect on infestation of varying the date of planting indicate that maize should not be planted in heavy soil before 26th April.

Entomology and Zoology.—*Rep. S. Carolina Exp. Sta.* **52** (1938–39) pp. 77–80. Clemson Coll., S.C., 1939. [Recd. 1940.]

No widespread outbreaks of insect pests occurred in South Carolina during 1939. F. Sherman and O. L. Cartwright report that emergence of adults of *Chalcodermus aeneus*, Boh., from hibernation in cages continued from 10th May to 28th June, with a peak on 17th June;

32 per cent. of the weevils that entered hibernation survived the winter. The first active weevils in the field were taken on newly germinated cowpeas during the last week of April; oviposition was first observed on 15th June and continued as long as cowpeas were available. In insectary cages, 10 pairs of weevils that mated as they emerged from hibernation produced an average of 152 eggs each. Adults reared from these eggs began ovipositing on 3rd August; the numbers of eggs laid averaged 28. Only one of 10 pairs of second-generation adults produced eggs; very few were laid, and the first was observed on 17th September. The duration of development from oviposition to adult emergence averaged 27·33 days. Development from oviposition to the emergence of the larvae from the seeds averaged 10·8 days, from emergence to pupation 4·94 days, and the pupal stage 8 days. The numbers of larvae emerging from the first 500 cowpeas from seed sown on 1st and 16th May and 1st June were 434, 246 and 123, respectively. Late maturing varieties escaped heavy infestation.

O. L. Cartwright records the results of surveys in 1938 and 1939 of the status of parasites of the oriental fruit moth [*Cydia molesta*, Busck] on peach. The maximum percentage parasitism by *Macrocentrus ancylivorus*, Rohw., in one county in which it was released in 1938 was 46·6 in that year, but did not exceed 6 in 1939; it was also disappointing in two other counties in which releases were made in 1938. It continued to be dominant in two counties in which it was already established, however, and gave a maximum percentage parasitism of over 94 in one area in 1939.

Bondy (F. F.) & Rainwater (C. F.). **Boll Weevil and miscellaneous Cotton Insect Investigations.**—*Rep. S. Carolina Exp. Sta.* **52** (1938–39) pp. 124–134, 3 figs. Clemson Coll., S.C., 1939. [Recd. 1940.]

Work in 1939 on the control of the boll weevil [*Anthonomus grandis*, Boh.] on cotton in South Carolina confirmed the value of the pre-square treatment with a mixture of calcium arsenate, molasses and water, applied with a mop, followed by dusting with calcium arsenate and lime [*cf. R.A.E.*, A **28** 473]. Comparative tests of 6 mopping mixtures for pre-square treatments showed that all were effective and that starch, wheat paste or gum can be substituted for the molasses and cryolite for the calcium arsenate. Investigations on the comparative toxicity to the weevil of various substitutes for calcium arsenate in dusts were inconclusive, but several synthetic cryolites, sodium fluosilicate and barium fluosilicate were inferior in dusting qualities to calcium arsenate and even in excessive quantities did not give the desired coverage. The addition of equal parts of a fixed nicotine dust (nicotine bentonite or nicotine tannate) to the calcium arsenate dust reduced the numbers of leaf Aphids [*Aphis gossypii*, Glov.] by over 50 per cent., as compared with the plots on which calcium arsenate was used alone, while the addition of 0·5 per cent. rotenone to the cryolites and barium fluosilicate reduced them by 88·3 and 76·06 per cent., respectively, as compared with the calcium arsenate plots. Derris, cubé or nicotine sulphate were added to some of the calcium arsenate dusts used on the larger field plots, and in all cases prevented the development of damaging Aphid infestation. Calcium arsenate was shown to be toxic to Coccinellids feeding on Aphids on cotton.

Injury to seedling cotton by the root Aphids, *Trifidaphis phaseoli*, Pass., *Anuraphis maidi-radicis*, Forbes, and *Rhopalosiphum subterraneum*, Mason, is increasing in eastern and south-central districts [*cf.* **26** 645]. The three Aphids may be present on the roots singly or in combination, but *T. phaseoli* is the most injurious. None of six repellents, including several essential oils, mixed with bone meal applied to the soil before planting or with ground tobacco stems and leaves as a side-dressing, gave satisfactory results. The most effective poison for *Lasius* sp., which attends the Aphids, was a mixture of tartar emetic and honey. No control of ants or Aphids resulted from fumigating the soil with emulsions of ethylene dichloride or dichloroethyl ether.

Allen (N.), Schifino (L. A.) & Webb (J. M.). **Tobacco Insect Investigations.**—*Rep. S. Carolina Exp. Sta.* **52** (1938-39) pp. 142–146, 2 figs. Clemson Coll., 1939. [Recd. 1940.]

The tobacco hornworm [*Protoparce sexta*, Joh.] was more abundant earlier in the season on tobacco in South Carolina during 1939 than normally, and caused the maximum amount of damage for ten years. *Epitrix parvula*, F., was normally abundant, and although it did not become a major pest during the season, experiments on its control were carried out. In a few tests in 1938 on small tobacco plant-beds, paradichlorobenzene crystals, which are used for the control of blue mould on tobacco, applied at the rate of 3 oz. per sq. yd. on a board round the edge of the bed, gave satisfactory mortality of the flea-beetles when the canvas drawn over the plants at night had 64 threads per linear inch. Further tests in March–May 1939 showed that the crystals applied at rates of ¼–2 oz. per sq. yd. were not toxic and only very slightly repellent when ordinary canvas was used. When the canvas had 38–64 threads per linear inch, a few beetles were killed, some were stupefied, and there was some repellent action, probably due to a concentration of fumes. In late-season tests on artificially infested plants remaining in the plant-beds after transplanting was completed, paradichlorobenzene at rates of ¼–1 oz. per sq. yd. gave poor results and was much less effective than a cubé dust (1 per cent. rotenone) or a cryolite dust containing 80 per cent. sodium aluminium fluoride. The cryolite gave the most lasting protection to the plants.

Reid, jr. (W. J.) & Bare (C. O.). **Cabbage Insect Investigations.**—*Rep. S. Carolina Exp. Sta.* **52** (1938-39) pp. 177–180. Clemson Coll., S.C., 1939. [Recd. 1940.]

An account is given of studies during 1938 and 1939 on the control of *Plusia* (*Autographa*) *brassicae*, Riley, *Plutella maculipennis*, Curt., and *Pieris rapae*, L., larvae of which cause serious damage to spring cabbages in South Carolina, and also of *Heliothis armigera*, Hb., and several species of climbing cutworms, which injure the autumn crop. As arsenicals cannot safely be used on cabbages after the head begins to form [*cf. R.A.E.*, A **25** 467], dusts of derris and pyrethrum were tested ; each proved effective against larvae of some of the species, but derris was more effective against the population as a whole and could be used at greater dilutions ; neither was as effective as arsenical or fluorine compounds against cutworms. Field experiments indicated that a derris dust (1 per cent. rotenone), with clay as the diluent and

applied at intervals of 10 days, preceded, in the case of the autumn crop, by applications at the same intervals of calcium arsenate and hydrated lime (3 : 1) or equal parts of synthetic cryolite (83 per cent. sodium aluminium fluoride) and talc to control cutworms during the preheading stage, was the most practicable of the schedules tested.

WATTS (J. G.). **Insect Control Investigations.**—*Rep. S. Carolina Exp. Sta.* **52** (1938–39) pp. 189–194, 2 figs. Clemson Coll., S.C., 1939. [Recd. 1940.]

Larvae of *Diaphania nitidalis*, Stoll, cause serious injury to the fruits of cucurbits in South Carolina during the late summer and autumn. They feed very rapidly and tunnel directly to the interior of the fruit, so that the period during which they can be reached by an insecticide is very short. In 1939, the adults were active in early June, and half-grown larvae were observed in mid-June, so that serious damage to the main melon crop was anticipated. Some control was given on field plots by three applications at five-day intervals, just prior to and during the early part of the harvest season, of a cubé dust (1·25 per cent. rotenone), but in cage tests with several insecticides, including cubé, in dusts and sprays, the only one to give any mortality of the larvae was a dust of 10 per cent. lead arsenate, which killed 51 per cent.

Hippodamia convergens, Guér., migrated in more than usual numbers to asparagus fields in May and June 1939 and fed extensively on the eggs of the asparagus beetle [*Crioceris asparagi*, L.]. Hot weather in June and July prevented the Criocerid from increasing, and the population remained at a low level. In cage tests, the highest percentage mortality (84·4) of adults was given by a dust of 10 parts calcium arsenate, 70 parts kaolin and 20 parts bentonite. The percentage mortality in controls was 10·9.

BARTLETT (K. A.). **The Introduction and Colonisation of the Amazon Fly, *Metagonystylum minense*, Tns., in Puerto Rico.**—*Proc. int. Soc. Sug. Cane Tech.* **6** pp. 243–245, 5 refs. Baton Rouge, La., 1939. [Recd. 1940.]

In view of the failure of an attempt made in 1935 to introduce *Metagonistylum minense*, Tns., into Porto Rico from British Guiana for the control of *Diatraea saccharalis*, F., on sugar-cane, a further attempt was made in 1937. Larvae of *D. saccharalis* collected in British Guiana in September showed a parasitism of 25 per cent. ; one generation of *M. minense* was reared in the laboratory, from which 110 adults and 606 pupae were shipped to Porto Rico during September and October. The parasites were readily reared in the laboratory in Porto Rico. Females were dissected 7 days after fertilisation, and the larvae were teased out of the uteri in saline solution (1 gm. sodium chloride per litre) and deposited on larvae of *D. saccharalis* that had previously been dipped in saline solution. The inoculated host larva was then inserted into a cavity made in a piece of cane stalk by splitting it down about half its length and removing part of the centre, the split cane being held together by a rubber band. This method was later modified by placing unparasitised *Diatraea* larvae in shell vials containing 1½ in. lengths of Guatemala grass [*Tripsacum laxum*], which lasts longer than cane and in which they constructed feeding tunnels within 24–48 hours. At inoculation, the stalk was dipped into saline

solution, the parasite larva placed directly on the host larva in the tunnel, and the cane or grass placed upright on a layer of moist bagasse or sawdust in a galvanised container ; the grass stalks remained in a better condition when arranged in groups of 4 or 5 separated by partitions of 1 in. mesh wire. After 10 days, the containers were placed in cages.

Mated females of *M. minense* contain up to several hundred eggs, most of which are mature 7–9 days after fertilisation. As many as 100–150 host larvae, each receiving 2–3 parasites, can be inoculated from one female, and as many as 5 parasites have been reared from a single host. The parasite larva enters its host between the segments and attaches itself to the tracheal tubes ; after 6–12 days it emerges, but still feeds to some extent on the host remains, and forms a puparium within 24 hours. The period between inoculation and the emergence of the adult occupied about 16 days when the mean temperature was 77°F. and 21 days when it was 72°F.

A total of 11,123 parasites was released at 4 places in Porto Rico between September 1937 and August 1938 ; recoveries were made at two of them in February 1938, when 13·8 and 1·4 per cent. of the larvae of *D. saccharalis* collected were parasitised. Two shipments of *M. minense* were sent to Florida and Louisiana from Porto Rico in May 1938.

DA COSTA LIMA (A.). **Alguns parasitos de moscas de frutas.** [Some Parasites of Fruit-flies.]—*Ann. Acad. brasil. Sci.* **12** no. 1 pp. 17–20, 7 figs. Rio de Janeiro, 1940.

Parasites reared from puparia of Diptera in Brazil and received for identification by the author comprise the Cynipids, *Ganaspis carvalhoi*, Dettmer, from *Anastrepha fraterculus*, Wied., and *A. serpentina*, Wied., *Eucoila* (*Pseudoeucoila*) *brasiliensis*, Ashm., from *A. fraterculus* and *Drosophila* sp. and *E.* (*Tropideucoila*) *weldi*, sp. n., described from a single female from *Lonchaea pendula*, Bezzi, and the Diapriid, *Trichopria anastrephae*, sp. n., described from both sexes from *Anastrepha* sp. from *Spondias dulcis* and *A. serpentina*.

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